OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

WASHINGTON, D.C. 20460

June 26, 2025

PC Code: 126002
Task Group: 660561

MEMORANDUM

SUBJECT: **Cyclobutrifluram:** Ecological Risk Assessment and Biological Evaluation including Effects Determinations for Federally Listed Endangered and Threatened Species and Designated Critical Habitats for the Section 3 Registration of a New Active Ingredient

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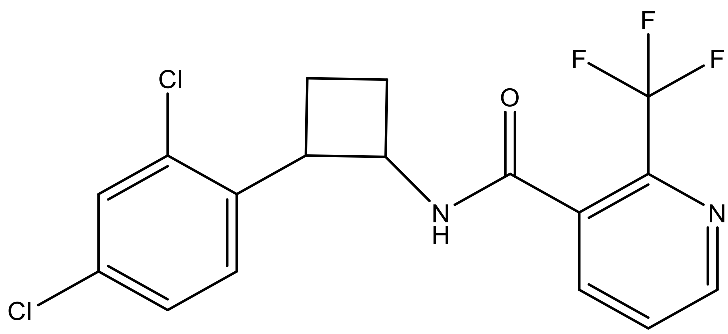
The Environmental Fate and Effects Division (EFED) completed the ecological risk assessment and biological evaluation (BE) with listed species effects determinations in support of the New Chemical Registration of the nematicide/fungicide cyclobutrifluram. This final assessment incorporates public comments[1] received and input from the U.S. Fish and Wildlife Service during technical discussions on the draft ecological risk assessment and BE.

[1] https://www.regulations.gov/docket/EPA-HQ-OPP-2022-0003

The conclusions conveyed in this assessment were developed in full compliance with *EPA Scientific Integrity Policy for Transparent and Objective Science*, and EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions.* The full text of *EPA Scientific Integrity Policy for Transparent and Objective Science*, as updated and approved by the Scientific Integrity Committee and EPA Science Advisor can be found here: https://www.epa.gov/scientific-integrity/epas-scientific-integrity-policy. The full text of the EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions* can be found here: https://www.epa.gov/scientific-integrity/approaches-expressing-and-resolving-differing-scientific-opinions.

Section 3 New Chemical Ecological Risk Assessment and Biological Evaluation for Cyclobutrifluram



Cyclobutrifluram; CAS No 1460292-16-3
USEPA PC Code: 126002

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June 26, 2025

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List of Acronyms

a.i.	Active Ingredient
APEZ	Aquatic Plant Exposure Zone
BE	Biological Evaluation
Bee-REX	Bee Residue EXposure model
BiOp	Biological Opinion
CH	Critical Habitat
CoA	Census of Agriculture
CONUS	Contiguous United States
DT_{50}	Dissipation (or degradation) Time required for the concentration to decline to half of the initial value
DT_{90}	Dissipation (or degradation) Time required for the concentration to decline to 10% of the initial value
EC_{25}	Concentration leading to 25% Effect
EC_{50}	Concentration leading to 50% Effect
ECOSAR	ECOlogical Structure-Activity Relationship Model
ECOS	Environmental Conservation Online System
EEC	Estimated Environmental Concentration
EFED	Environmental Fate and Effects Division
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GIS	Geographic Information System
HUC-2	Hydrologic Unit Code 2-digit
IC_{25}	Concentration leading to 25% Inhibition
J/AM	Jeopardy/Adverse Modification
KABAM	KOW (based) Aquatic BioAccumulation Model
Kg a.i./ha	Kilograms of Active Ingredient per Hectare
LAA	Likely to Adversely Affect
lb a.i./A	Pounds of Active Ingredient per Acre
LC_{50}	Concentration leading to 50% Mortality
LD_{50}	Dose leading to 50% Mortality
LOAEC	Lowest Observed Adverse Effect Concentration
LOAEL	Lowest Observed Adverse Effect Level
LOC	Level of Concern
LOQ	Level of Quantitation
MA	May Affect
MATC	Maximum Acceptable Toxicant Concentration
MRID	Master Record Identification
NA	Not Applicable or Not Available
NC	Not Calculated or Not Calculable
NE	No Effect
NL48	Non-lower 48 (i.e., U.S. territories outside of CONUS including Hawaii, Alaska, and U.S. territories)
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Level

PAT	Plant Assessment Tool
PCE/PBF	Principal Constituent Elements / Physical or Biological Features
PPHD	Prey, Pollination, Habitat, and/or Dispersal
PRZM	Pesticide Root Zone Model
PWC	Pesticide in Water Calculator
ROC	Residues of Concern
RQ	Risk Quotient
SAP	Scientific Advisory Panel
SC	Suspension Concentrate
SE	Seedling Emergence
TEP	Typical End-Use Product
TFA	Trifluoroacetic Acid
TGAI	Technical Grade Active Ingredient
TPEZ	Terrestrial Plant Exposure Zone
T-REX	Terrestrial Residue EXposure model
UDL	Use Data Layer
USDA	United States Department of Agriculture
USFWS or FWS	United States Fish and Wildlife Service
VV	Vegetative Vigor
VVWM	Variable Volume Water Model
WPEZ	Wetland Plant Exposure Zone

1 Executive Summary

1.1 Overview

The Environmental Fate and Effects Division (EFED) completed the new chemical assessment in support of the proposed registration for the Group N-3 nematicide and Group 7 fungicide cyclobutrifluram[2] (Cas No. 1460292-16-3; alternate names: SYN549522 and TYMIRIUM® technology; brand names: A22011 Crop, A22011 T&O (Trefinti®, Trefinti® Flora, Trefinti® TL), A22417 ST (Victrato™), A23156 Crop). This is a chiral compound containing 2 stereoisomers, S, S isomer SYN547386 (>90%; Cas No. 1644251-74-0) and R, R isomer SYN548941 (<10%; Cas No. 2192196-56-6). One technical product, 85% active ingredient (a.i.; w/w), and 4 end-use products are proposed for registration in the United States for the control of parasitic nematodes and of soil-borne and foliar fungal diseases affecting agricultural crops (romaine lettuce, soybean, and cotton), turf, and ornamentals (**Table 2-1**). Cyclobutrifluram is considered systemic and affects respiration through disruption of mitochondrial complex II by inhibition of succinate dehydrogenase, belonging to the chemical groups pyridinyl-ethyl-benzamides, phenethyl pyridineamides,[3] and phenyl-cyclobutyl-pyridineamide.[4] Available data discussed in this assessment indicate cyclobutrifluram to be environmentally persistent (half-lives typically several hundred days in various media), but bioaccumulation in aquatic food webs is not considered an exposure route of concern. No single degradate was consistently found above 10% of applied over the duration of the submitted studies regarding metabolism in soil and water; therefore, the residue of concern is considered parent chemical only. Volatilization is not expected to be a significant source of dissipation.

This assessment examined the potential ecological risks associated with the proposed labeled uses of cyclobutrifluram on non-target organisms, both listed and non-listed species. The Residues of Concern (ROC) include the parent cyclobutrifluram only. Estimated Environmental Concentrations (EECs) were compared to cyclobutrifluram toxicity endpoints. For more information on the ROC see **Section 3**.

1.2 Taxon-Level Risk Conclusions and ESA-Listed Species Effects Determinations

1.2.1 Taxon-Level Risk Conclusions

Based on available data, the proposed uses of cyclobutrifluram do not pose acute or chronic risks to aquatic animals (*e.g.,* fish, amphibians, aquatic invertebrates). Similarly, no risk is

[2] Chemical name: N-[(1S,2S)-2-(2,4-dichlorophenyl)cyclobutyl]-2-(trifluoromethyl)pyridine-3-carboxamide; N-[(1R,2R)-2-(2,4-dichlorophenyl)cyclobutyl]-2-(trifluoromethyl)pyridine-3-carboxamide; the potential impacts of the chirality of this molecule have not been fully assessed, and additional data may be needed for future assessments.
[3] https://irac-online.org/documents/nematicides-moa-classification/?ext=pdf
[4] https://www.frac.info/frac-teams/working-groups/sdhi-fungicides/information

expected for aquatic, wetland[5], or terrestrial plants. For terrestrial animals (*e.g.,* birds, mammals, terrestrial invertebrates), acute risks are not expected. Taxon-level analyses indicate a potential for effects to birds and mammals from consumption of treated cotton and/or soybean seeds and potential impacts to terrestrial invertebrates from turf and ornamental uses. EFED considered refinements to better understand and characterize potential risks to these taxa. **Table 1-1** summarizes the taxon-level risk conclusions for the proposed uses of cyclobutrifluram.

Birds: For the proposed uses of cyclobutrifluram, EPA initially found a potential for chronic risk (**Table 1-1**) for non-listed and listed birds (RQ range: <0.01 - **2.4**) from consumption of treated cotton seeds. In further characterizing this risk, based on the amount of chemical on each seed and the number of treated seeds needed to reach a level of concern, birds would need to consume a greater number of seeds than their daily dietary requirements to trigger a chronic risk concern. In addition, these risk calculations are based on avian reproduction studies where no significant effects were detected, and the NOAEC was set at the highest concentration tested. Therefore, these chronic risks predictions for birds may overestimate risk since the toxicological threshold for chronic effects (*i.e.,* the LOAEC) was not achieved. Therefore, risk is considered low from birds consuming seeds treated with cyclobutrifluram.

Mammals: EPA found there is a potential for chronic risk for non-listed and listed mammals (RQ range: <0.01 - **10**) based on seed treatment uses for cotton and soybean via consumption of treated seed. In further characterizing this risk, based on the amount of chemical on each seed and the number of treated seeds needed to reach a level of concern, the number of cotton or soybean seeds mammals need to consume to reach the chronic level of concern is within the daily dietary limits for small, medium, and large mammals. These risk calculations are based on a mammalian reproduction study where no significant effects to reproduction or growth were detected, and the NOAEC/NOAEL was set at the highest concentration tested. Therefore, these chronic risks predictions for mammals may overestimate risk since the toxicological threshold for chronic effects (*i.e.,* the LOAEC/LOAEL) was not achieved.

Terrestrial invertebrates: EPA found there is potential for chronic risks to honey bees, adult (RQ range: 0.01 - **1.2**) and larva (RQ range: 0.13 - **19**), from cyclobutrifluram exposure through turfgrass foliar applications, but due to label language restricting applications when flowering/blooming weeds/plants are present, the risk for honey bees is considered low. EPA considered the available data for honey bees and other non-target arthropods to assess potential risks to other types of invertebrates that may be present on turf and ornamentals use sites but not consume pollen and nectar (and may still be exposed even with the prohibition of applications when blooming flowers are present). For adult honey bees, EPA based its risk calculations on a study where no significant effects were detected, and the NOAEC was set at

[5] For the purposes of this assessment a wetland is a shallow waterbody that may include permanently or intermittently flooded areas. Examples include wet meadows, marshes, swamps, and riparian areas. In this document, EPA is not referring to a wetland as defined under the Clean Water Act.

the highest concentration/dose tested. Therefore, these chronic risks predictions for adult honey bees overestimate risk since the toxicological threshold for chronic effects (*i.e.,* the LOAEC/LOAEL) was not achieved for adult honey bees. For larval honey bees, EPA used the NOAEC in calculating the potential risk based on a 22-day larval chronic study, where significant effects to mortality (↑33%) and adult emergence (↓41%) were observed at the LOAEC. Several studies conducted with additional terrestrial invertebrates considered to be beneficial arthropods suggest cyclobutrifluram has the potential to disrupt reproduction in terrestrial invertebrates. Assessment of risk potential for listed terrestrial invertebrates relies on the data from all submitted cyclobutrifluram studies for terrestrial invertebrates (honey bees and other beneficial arthropods) and is evaluated in conjunction with the assessment for non-listed terrestrial invertebrates (primarily relies on evaluation of honey bee risk and pollen/nectar consumption) to account for dietary items such as leaves and arthropod prey. For listed terrestrial invertebrates, there is no identified risk from contact exposure (soil, spray droplets, or treated surfaces), but there is potential for chronic dietary exposure risk (from leaves and arthropod prey) based on proposed uses for turf and ornamentals (RQ range: <0.01 - **10**). Potential risk is limited to treated areas, as exposure off field (e.g., from spray drift) is not reasonably certain to reach the level of concern.

Table 1-1. Summary of Risk Quotients for Taxonomic Groups from Proposed Uses of Cyclobutrifluram

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
			Non-listed Species	Listed Species	
Freshwater Fish	Acute	<0.01	No	No	--
	Chronic	<0.01 - 0.01	No	No	--
Estuarine/ Marine Fish	Acute	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Chronic	<0.01 - 0.03	No	No	--
Freshwater Invertebrates (Water-Column Exposure)	Acute	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Chronic	<0.01 - 0.02	No	No	--
Estuarine/ Marine Invertebrates (Water-Column Exposure)	Acute	0.01 - 0.05	No	No	--
	Chronic	0.01 - 0.09	No	No	--
Freshwater Invertebrates (Sediment Exposure)	Subchronic	Acute:[2] NC Chronic: <0.01 - 0.03	No	No	--

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
			Non-listed Species	Listed Species	
Estuarine/Marine Invertebrates (Sediment Exposure)	Subchronic	Acute:[2] 0.01 - 0.05 Chronic: <0.01	No	No	--
Birds	Acute	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Dietary	NC	No	No	Non-definitive acute endpoint; exposure is below highest tested levels where there were no effects.
	Chronic	<0.01 - **2.4**	Yes	Yes	LOC exceedances based on cotton seed treatment. Non-definitive LOAEC. No effects observed up to the highest test concentrations. Risk for birds from consumption of treated seeds is expected to be low. Daily diets would need to consist of greater than 100% treated seeds to reach the number of seeds of concern.
Mammals	Acute	NC	No	No	Non-definitive acute endpoint.
	Chronic	<0.01 – **10**	Yes	Yes	LOC exceedances based on seed treatment applications. Non-definitive LOAEC. No effects observed up to the highest test concentrations. Daily diets would need to consist of 10-98% treated seeds to reach the number of seeds of concern.

<table>
<tr><th rowspan="2">Taxa</th><th rowspan="2" colspan="2">Exposure Duration</th><th rowspan="2">Risk Quotient (RQ) Range[1]</th><th colspan="2">RQ Exceeding the LOC</th><th rowspan="2">Additional Information/ Lines of Evidence</th></tr>
<tr><th>Non-listed Species</th><th>Listed Species</th></tr>
<tr><td rowspan="9">Terrestrial Invertebrates[3]</td><td colspan="2">Acute Adult</td><td>NC</td><td>No</td><td>No</td><td rowspan="4">Non-definitive acute endpoints.

Chronic LOC exceedances for adults and larvae based on turf use.

Non-definitive LOAEL for adult chronic study. No effects observed up to the highest test dose.

Risk to honey bees is expected to be low, due to restrictions on the label to avoid applying in the presence of blooming plants.

Studies conducted with other terrestrial invertebrates suggest the potential for reproductive effects.</td></tr>
<tr><td colspan="2">Chronic Adult</td><td>0.01 – 1.2</td><td>Yes</td><td>Yes</td></tr>
<tr><td colspan="2">Acute Larval</td><td>NC</td><td>No</td><td>No</td></tr>
<tr><td colspan="2">Chronic Larval</td><td>0.13 - 19</td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="3">Listed Species-Contact</td><td>Soil[4]</td><td><0.01</td><td rowspan="5"></td><td>No</td><td>--</td></tr>
<tr><td>Spray Droplets[5]</td><td>NC</td><td>No</td><td>Non-definitive endpoint. No effects observed up to the highest test dose.</td></tr>
<tr><td>Treated Surfaces[6]</td><td>0.37</td><td>No</td><td>Representative of chronic exposure.</td></tr>
<tr><td rowspan="2">Listed Species - Dietary[7]</td><td>Acute</td><td>NC</td><td>No</td><td>Non-definitive acute endpoints; exposure is below highest tested levels where there were no effects.</td></tr>
<tr><td>Chronic</td><td><0.01 - 10</td><td>Yes</td><td>Chronic LOC exceedances for larvae, based on turf and ornamental uses, for consumption of tall grass, broadleaf plants, and arthropods.</td></tr>
<tr><td>Aquatic Plants</td><td colspan="2">NA</td><td>Non-Listed:
<0.01 - 0.01
Listed:
<0.01 - 0.12</td><td>No</td><td>No</td><td>--</td></tr>
<tr><td>Semi-Aquatic Plants</td><td colspan="2">NA</td><td>Non-Listed:
NC
Listed:
0.01 - 0.16</td><td>No</td><td>No</td><td>Non-definitive endpoint for non-listed species; exposure is below highest tested levels where there were no effects.</td></tr>
</table>

Taxa	Exposure Duration	Risk Quotient (RQ) Range[1]	RQ Exceeding the LOC		Additional Information/ Lines of Evidence
			Non-listed Species	Listed Species	
Terrestrial Plants	NA	Non-Listed: NC Listed: 0.01 - 0.43	No	No	Non-definitive endpoint for non-listed species; exposure is below highest tested levels where there were no effects.

Level of Concern (LOC) Definitions:
Terrestrial Vertebrates: Acute (non-listed)=0.5; Acute (listed)= 0.1; Chronic=1.0
Terrestrial Invertebrates: Acute (non-listed)=0.4; Acute (listed)= 0.05; Chronic=1.0
Aquatic Animals: Acute (non-listed)=0.5; Acute (listed)= 0.05 Chronic=1.0
Plants: 1.0
Bold values exceed the LOC for non-listed and listed species.
NC=Not Calculable; NA=Not Applicable
[1] RQs reflect exposure estimates for cyclobutrifluram and maximum application rates allowed on labels.
[2] Based on water-column toxicity data compared to pore-water concentration.
[3] RQs for non-listed terrestrial invertebrates are applicable to honey bees, which are also a surrogate for other species of bees. RQs for listed terrestrial invertebrates include considerations of honey bees and other terrestrial invertebrates (*e.g.*, earthworms, beneficial arthropods) when toxicity data are available.
[4] Based on earthworm (*Eisenia andrei*) sub-lethal reproduction study.
[5] Based on honey bee (*Apis mellifera*) contact exposure study.
[6] Based on parasitic wasp (*Aphidius rhopalosiphi*) mortality and reproduction study.
[7] Based on honey bee (*A. mellifera*) acute and chronic oral toxicity studies.

1.2.2 ESA-Listed Species Effects Determination Summary

The taxon-based portion of the assessment serves as the basis for determining which taxonomic groups needed further species-specific review to support the effects determinations in the biological evaluation (BE) for listed species. EPA identified the following taxon-based risks: growth effects to mammals from direct consumption of treated cotton and soybean seeds and effects to terrestrial invertebrate larvae from applications to turf and ornamentals. No risks were identified for the romaine lettuce use. The identified risks are limited to the treated sites, with no risk concerns for offsite transport. Direct effects are not a concern for the following taxa: birds, amphibians, reptiles, fish, aquatic invertebrates, and plants. For the ESA-listed species assessment, EPA evaluated direct effects to seed eating mammals on agricultural fields and terrestrial invertebrate larvae that may occur on turf and ornamental use sites. EPA also considered potential indirect impacts to the prey, pollination, habitat, or dispersal (PPHD) of listed species that depend on mammals and terrestrial invertebrates and may experience effects from effects to mammals that consume seeds (specifically treated cotton or soybean) or terrestrial invertebrates that occur on turf and ornamentals use sites. Due to the pollinator protection language included on the proposed label for turf and ornamentals, restricting applications at bloom and drift to flowering plants, exposure to bees and other insects that solely consume pollen and/or nectar is not reasonably certain to occur. For the ESA-listed species assessment, EPA considered exposures to terrestrial invertebrates that consume other dietary items (e.g., broadleaves, other invertebrates).

The action area assessed for this biological evaluation (BE) includes the spatial locations in the U.S. where proposed use sites for cotton, soybean, turf, and ornamentals occur[6]. *Action area* means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action[7]. EPA estimated the percentage of overlap between the action area and the individual listed species ranges and designated critical habitats (listed as of December 2023) using the Use Data Layer (UDL) Overlap tool version 2[8]. The proposed use on romaine lettuce was evaluated in this assessment, but EPA did not include romaine lettuce in the assessed spatial locations for UDL overlap analysis, because no taxon-level risks were identified from this use. In additon, EPA did not buffer the use sites, because exposure from off-site transport is not a concern.

EPA made listed-species effects determinations using 1) the risk conclusions from the taxon-based assessment, 2) listed-species specific information on taxon, prey, pollination, habitat, and dispersal, and 3) overlap of species range and proposed cyclobutrifluram use sites. For critical habitat (CH), a similar approach was used, where EPA used 1) the risk conclusions from the taxon-based assessment, 2) physical or biological features (PBFs) of the CH, and 3) overlap of CH and proposed cyclobutrifluram use sites.

EPA made No Effect (NE) determinations for listed species or CHs based on the following criteria:

1) Species range or CH is outside of the action area (i.e., exposure is not expected, because there is no overlap[9]);
2) Direct and indirect effects are not reasonably certain to occur (despite an overlap of the species range/CH and action area). Includes species that are not any of the following:
    a. Listed mammals that eat seeds on cotton or soybean fields,
    b. Dependent (e.g., for prey or habitat) on seed eating mammals on cotton or soybean fields,

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[6] Based on statements in the proposed labels, the applicant is considering not registering proposed uses of cyclobutrifluram in California (all uses) and New York (cotton statewide; turf and ornamentals in specific counties); however, those statements are not currently a requirement on the proposed labels. If labels are amended to make these statements a requirement, any species or critical habitats located only within the excluded areas would be categorized as No Effect, as they would be outside of the action area.

[7] 50 CFR §402.02

[8] https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#overlap

[9] This assessment relies on EPA's pre-established overlap threshold to make NE determinations. <1% overlap represents an actual overlap of <0.45. The overlap percentage is rounded to whole numbers due to the precision of the remotely sensed data. Overlap that is less than 0.45% represents no overlap. This is primarily because this level of overlap is beyond the precision of the overlap data and is not considered true overlap.
Details on the scientific support of this overlap threshold are provided in the UDL overlap tool user's guide (see p. 19, Appendices A-C; available online at: https://www.epa.gov/system/files/documents/2024-08/udl-overlap-tool-user-guide-v2.pdf)

    c. Listed terrestrial invertebrate larvae that consume plants or other invertebrates on turf and ornamental use sites; <u>and</u>
    d. Dependent (e.g., for prey or pollination) on terrestrial invertebrates that consume plants or other invertebrates on turf and ornamental use sites.

EPA made May Affect (MA) determinations for listed species or CHs based on the following criteria:

1) Species range or CH overlaps with the action area (i.e., overlap is >1%);
2) And at least one of the following applies to the species or CH:
    a. Listed mammals that eat seeds on cotton or soybean fields,
    b. Dependent (e.g., for prey or habitat) on seed eating mammals on cotton or soybean fields,
    c. Listed terrestrial invertebrate larvae that consume plants or other invertebrates on turf and ornamental use sites; <u>or</u>
    d. Dependent (e.g., for prey or pollination) on terrestrial invertebrates that consume plants or other invertebrates on turf and ornamental use sites.

For all MA species and CHs, EPA conducted additional analyses to consider the likelihood of effects. EPA considered whether exposure is discountable or whether effects are insignificant. Based on species-specific information, EPA made a Not Likely to Adversely Affect (NLAA) determination for listed species or CHs based on the following criteria:

1) Exposure is considered discountable, because the MA determination is based on direct effects and the listed species/CHs are not reasonably expected to coincide with the proposed use sites based on:
    a. Habitat description,
    b. Host plants being considered off-field (terrestrial invertebrate larvae), or
    c. Spatial refinements reduce overlap potential to <1%;
2) Potential effects from exposure are expected to be insignificant when:
    a. The MA determination is based on indirect effects (not due to direct contact or dietary exposure) and the listed species/CH is considered off-field (because effects are not expected off field), or
    b. Based on habitat and dietary descriptions, effects to PPHD of the listed species/CH are not expected.

EPA relied on its listed species database (which is composed of information from US Fish and Wildlife Service [FWS] and National Marine Fisheries Service [NMFS]) to determine species specific diets and dependencies (e.g., pollinators and habitat). EPA also used the database to determine if listed species are likely to occur on cotton and soybean fields or turf and ornamental use sites. Additional information was obtained directly from the FWS Environmental Conservation Online System (ECOS),[10] when necessary. This information was used to make NE, MA, and NLAA (discountable or insignificant) determinations.

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

EPA made NE determinations for 1482 (out 1726) listed species and 847 (out of 944) CHs (**Table 1-2** and **Table 1-3**). EPA made NE determinations for all listed species and critical habitats of fish, aquatic invertebrates, and plants, because effects to these species from direct and indirect effects are not reasonably certain to occur. Although many listed plants depend on terrestrial insects as pollinators, EPA concluded that indirect effects to listed plants are not reasonably certain to occur, both because the pollinator protection restrictions included in this action that avoid exposures to pollinators from nectar and pollen consumption and because listed plants are not expected to occur on the treatment sites where insect effects may occur (i.e., turf and ornamentals). EPA made NE determinations for greater than 1400 species and 800 critical habitats under the authority of the US Fish and Wildlife Service (FWS) where effects are not reasonably certain to occur due to a lack of direct or indirect effects and/or no (<1%) overlap with the action area. EPA also made NE determinations for all listed species and critical habitats that fall under the authority of the National Marine Fisheries Service (NMFS) as these species are outside the action area. Therefore, EPA will not seek consultation with NMFS for this action.

Table 1-2. Summary of Effects Determinations for Federally Listed and Proposed Endangered and Threatened Species.

Taxonomic Group	# Species with Potential Direct Effects	# Species with Potential Indirect Impacts based on Impacts to:		Effects Determinations (# of Species)			Total # of Listed Species
		Mammals	Terrestrial Invertebrates	No Effect	Not Likely to Adversely Affect	Likely to Adversely Affect	
Amphibians	0	1	30	15	30	0	45
Aquatic Invertebrates	0	0	0	195	0	0	195
Birds	0	5	53	42	54	0	96
Fish	0	0	0	175	0	0	175
Mammals	2	6	40	51	45	0	96
Plants	0	0	0	944	0	0	944
Reptiles	0	4	13	41	15	0	56
Terrestrial Invertebrates	100	1	30	19	100	0	119
Total				1482	244	0	1726

Table 1-3. Summary of Effects Determinations for Designated and Proposed Critical Habitats (CHs).

Taxonomic Group	# CHs with Potential Direct Effects	# CHs with Potential Indirect Impacts based on Impacts to:		Effects Determinations (# of CHs)			Total # of CHs
		Mammals	Terrestrial Invertebrates	No Effect	Not Likely to Adversely Affect	Likely to Adversely Affect	
Amphibians	0	1	6	22	7	0	29
Aquatic Invertebrates	0	0	0	109	0	0	109
Birds	0	2	10	25	10	0	35
Fish	0	0	0	122	0	0	122
Mammals	4	6	13	36	15	0	51
Plants	0	0	0	505	0	0	505
Reptiles	0	0	6	22	6	0	28
Terrestrial Invertebrates	59	1	24	6	59	0	65
Total				847	97	0	944

EPA made MA determinations for 244 listed species of amphibians, birds, mammals, reptiles, and terrestrial invertebrates. EPA also made MA determinations for 97 CHs of species within these taxa. For all 244 species and 97 CHs with MA determinations, EPA made Not Likely to Adversely Affect (NLAA) determinations, because either exposure was discountable (72 listed species and 35 designated CHs) or potential effects were considered insignificant (172 species and 62 designated CHs). All of the listed species and CHs with NLAA determinations are under FWS authority. Therefore, EPA will informally consult with FWS on the proposed action for cyclobutrifluram.

1.3 Environmental Fate and Exposure Summary

The environmental fate dataset is complete for cyclobutrifluram parent, which was the sole stressor determined in the residues of concern (ROC). Many of the submitted studies were terminated while degradates were still increasing, often at maximum concentrations at the end of the study. Consequently, the extent of formation and the environmental persistence of degradates is largely undescribed. Nonetheless, the impact of the degradates on the total exposure (if they were to be included in the residues of concern) is inconsequential because the very high environmental persistence of the parent inputted into exposure models results in conservative exposure estimates. These estimates would not be substantively increased by adding in degradates to the total toxic residue modeled. Additionally, the available data indicate the degradates are less toxic than parent.

EPA found that cyclobutrifluram is not subject to hydrolysis and degrades with half-lives >100 days by most other exposure routes except for aqueous photolysis (estimated half-life 28 days). In aerobic soil metabolism studies cyclobutrifluram degraded with estimated half-lives of 198 to 1097 days in five test soils. Cyclobutrifluram dissipated from the soil profile (via through transformation or transport) in nine field dissipation studies with estimated time brackets to 50% disappearance time (DT_{50}) for each individual study ranging from 14 - 49 days to 63 - 271 days for the studies with the most rapid and least rapid dissipation, respectively. Significant carryover of cyclobutrifluram into the next year was observed in each of the field studies.

The potential for leaching to groundwater of cyclobutrifluram can be significant with long-term use where vulnerable aquifers are present, as indicated by K_{OC} values from 301 to 643 L/kg. The Koc values are in the moderately mobile to mobile range according to the FAO classification[11]. Cyclobutrifluram can be transported to surface waters via runoff and spray drift.

The log K_{OW} (octanol-water coefficient) of 3.2 (pH 7) for cyclobutrifluram, indicates the possibility of a concern to aquatic-feeding wildlife via bioaccumulation in the aquatic food web. However, the measured bioconcentration factor (BCF; 31 L/kg-wet weight) combined with model-predictions of bioaccumulation indicate low risk to aquatic-feeding wildlife.

There is limited degradate information not only due to the persistence of parent cyclobutrifluram in most environmental fate studies but also due to the fact that many of the theoretical degradates were not analyzed for or not detected in many studies. It appears that under some environmental conditions the degradates SYN510275 and possibly SYN510260 (derivatives of the triflluoromethyl pyridine ring after cleavage of the parent molecule) might form at high enough levels and persist for sufficiently long periods to become major metabolites. For example, combined residues of these two compounds did exceed 10% of applied in three soil column studies[12]. However, this is not certain to be generally the case as limited formation was confirmed in the other submitted environmental fate studies after a duration of up to 3 or 4 months. Eventually trifluoroacetic acid (TFA) is split from the pyrindyl ring. TFA is a compound formed from many xenobiotics and which may be mobile and persistent in the environment. TFA in available studies has only shown to have effects on various classes of organisms at concentrations significantly higher than those expected from the use of cyclobutrifluram (See, for example, Boutonnet et al, 1999; and Solomon et al, 2016). Another degradate that is a derivative of the 2,4-dichlorophenyl ring and was found to be a major product in a single field dissipation study and the soil photolysis study only is CGA177291 or 2,4-dichlorobenzoic acid. Overall, the available evidence does not indicate there is both a sufficient potential for exposure and level of toxicity to non-target organisms to include any of the degradates in the residues of concern for this risk assessment.

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[11] FAO. 2000. Appendix 2. Parameters of pesticides that influence processes in the soil. In FAO Information Division Editorial Group (Ed.), *Pesticide Disposal Series 8. Assessing Soil Contamination. A Reference Manual*. Rome: Food & Agriculture Organization of the United Nations (FAO). Available at http://www.fao.org/DOCREP/003/X2570E/X2570E06.htm

[12] See the summary of MRID 51460203 in Appendix B, Table 1.

1.4 Ecological Toxicity Summary

On an acute basis, EPA determined cyclobutrifluram to be practically non-toxic to estuarine/marine fish, freshwater aquatic invertebrates (water column), birds, mammals, and honey bees. For aquatic taxa, EPA determined cyclobutrifluram to be slightly toxic to freshwater fish and highly toxic to oysters.

For subchronic exposures to benthic invertebrates, significant effects ($p<0.05$) to survival (↓21%) at 940 µg a.i./L (pore water) were observed for freshwater invertebrates (Midge; *Chironomus dilutus*). No significant effects to estuarine/marine benthic invertebrates were noted. For earthworms (*Eisenia andrei*), on a subchronic basis, significant reductions in growth (body weight ↓67%) were observed at 1000 mg a.i./kg dw.

Chronic effects due to cyclobutrifluram exposure were observed across several aquatic and terrestrial species. For freshwater fish (Fathead Minnow; *Pimephales promelas*), significant reductions in length (↓6%) were observed at 4,700 µg a.i./L. For estuarine/marine fish (Sheepshead Minnow; *Cyprinodon variegatus*) significant reductions in growth (length ↓4%; dry weight↓11%; and wet weight ↓13%) were noted at 1,200 µg a.i./L. For freshwater invertebrates (Water Flea; *Daphnia magna*), length (↓4%), the number of live offspring (↓18%), successful birth rate (↓15%), and time to first brood (↑5%) were all significantly affected at 1,400 µg a.i./L. For estuarine/marine invertebrates (Mysid; *Americamysis bahia*), there were significant reductions in time to first brood (↓17%) at 310 µg a.i./L. For larval honey bees (*Apis mellifera L.*), significant effects to adult emergence (↓41%) and day 15 mortality (↑33%) were observed at 0.428 µg a.i./larva/day. For earthworms (*E. andrei*), significant reductions in the number of juveniles were noted across three studies at 309 mg a.i./kg dw (↓23%; TGAI), 212 mg a.i./kg dw (↓40%; TEP), and 128 mg a.i./kg dw (↓21%; TEP). No significant chronic effects were seen for birds, mammals, or adult honey bees.

For aquatic plants, significant reductions in frond yield (↓9%) were seen for vascular plants (Duckweed; *Lemna gibba*), and significant reductions in the AUC (↓77%), cell density (↓78%), and growth rate (↓28%) were observed at 8,900 µg a.i./L for non-vascular plants (Green Algae; *Raphidocelis subcapitata*).

For terrestrial plants, no effects to any species were observed in the vegetative vigor study. For seedling emergence, significant effects to survival (↓26%) and emergence (↓26%) were observed for Ryegrass (*Lolium perenne*), the only species affected by treatment exposure, at 0.80 lb a.i./A.

1.5 Identification of Data Needs

The environmental fate and ecological effects suites of data for cyclobutrifluram are complete at this time.

1.6 40 CFR Part 158 Data Requirements

The following tables summarize the status of environmental fate and ecological effect data requirements specified in Title 40 Part 158 of the Code of Federal Regulations (40CFR158) (sections §630, §660 and §1300) for the registration of conventional pesticides for terrestrial uses (agricultural and non-agricultural) for cyclobutrifluram. EPA determined the applicable data requirements based on the proposed use patterns and the environmental fate and ecological effect data for a pesticide. The tables below note the status of the terrestrial and aquatic non-target organism (**Table 1-4**), non-target plant protection (**Table 1-5**), and environmental fate (**Table 1-6**) data requirements. Based on the information contained in the subsequent tables, all relevant data requirements specified in the 40 CFR Part 158 have been completed, waived, or were not triggered.

Table 1-4. Cyclobutrifluram Terrestrial and Aquatic Non-Target Organism Data Requirements to Support Section 3 New Active Ingredients.

Guideline Number - Study Type		Required	Data Requirement Status
Birds (surrogates for terrestrial amphibians and reptiles)			
850.2100 - Avian Acute Oral Toxicity Test	Passerine	Yes	**Complete**
	Upland Game or Waterfowl	Yes	**Complete**
850.2200 - Avian Sub-acute Dietary Toxicity Test	Waterfowl	Yes	**Complete**
	Upland Game Bird	Yes	**Complete**
850.2300 - Avian Reproduction Test	Waterfowl	Yes	**Complete**
	Upland Game Bird	Yes	**Complete**
Mammals			
850.2400 - Wild Mammal Toxicity Testing		No[1]	**Not Triggered**
850.2500 - Field Testing for Terrestrial Wildlife		No[1]	**Not Triggered**
Aquatic Invertebrates Acute Toxicity (Water-Column Exposure)			
850.1010 - Aquatic Invertebrate Acute Toxicity Test, Freshwater Daphnids		Yes	**Complete**
850.1025 - Oyster Acute Toxicity Test (Shell Deposition)		Yes	**Complete**
850.1035 - Mysid Acute Toxicity Test		Yes	**Complete**
850.1045 - Penaeid Acute Toxicity Test		No[1]	**Not Triggered**
850.1055 - Bivalve Acute Toxicity Test (Embryo-Larval)		No[1]	**Not Triggered**
Fish Acute Toxicity (surrogates for aquatic-phase amphibians)			
850.1075 - Freshwater Fish Acute Toxicity Test	Coldwater species	Yes	**Complete**
	Warmwater species	Yes	**Complete**
850.1075 - Saltwater Fish Acute Toxicity Test		Yes	**Complete**
Aquatic Invertebrate Chronic Toxicity			
850.1300 - Daphnid Chronic Toxicity Test		Yes	**Complete**
850.1350 - Mysid Chronic Toxicity Test		Yes	**Complete**
Fish Chronic Toxicity			
850.1400 - Freshwater Fish Early Life Stage (ELS) Toxicity Test		Yes	**Complete**
850.1400 - Estuarine/ Marine Fish Early Life Stage (ELS) Toxicity Test		Yes	**Complete**

Guideline Number - Study Type		Required	Data Requirement Status
850.1500 - Fish Life Cycle Toxicity Test	Freshwater	No[1]	**Not Triggered**
	Estuarine/Marine	No[1]	**Not Triggered**
Bioconcentration Factor (BCF) Study			
850.1710 - Oyster Bioconcentration Factor (BCF)		No[1]	**Not Triggered**
850.1730 - Fish Bioconcentration Factor (BCF)		Yes	**Complete**
Aquatic Invertebrates Acute Toxicity (Benthic Exposure)			
850.1735 - Spiked Whole Sediment 10-Day Toxicity Test, Freshwater Invertebrates	Midge	Yes	**Complete**
	Freshwater Amphipod	Yes	**Complete**
850.1740 - Spiked Whole Sediment 10-Day Toxicity Test, Saltwater Invertebrates		Yes	**Complete**
Non-guideline - Whole sediment: chronic (28-65-Day life cycle) Toxicity Test	Freshwater midge	Yes	**Waived**
	Freshwater amphipod	Yes	**Waived**
	Estuarine/Marine amphipod	Yes	**Waived**
Other Aquatic Studies			
850.1850 - Aquatic food chain transfer		No[1]	**Not Triggered**
850.1950 - Field testing for aquatic organisms		No[1]	**Not Triggered**
Terrestrial Invertebrate Toxicity (Surrogate for both *Apis* and non-*Apis* bees)			
850.3020 (OECD Test Guideline 214)- Honey Bee [Adult] Acute Contact Toxicity Test		Yes	**Complete**
OECD Test Guideline 213 - Honey Bee Adult Acute Oral (AAO) Toxicity Test		Yes[2]	**Complete**
OECD Test Guideline 237 - Larval Honey Bee Acute Oral (LAO) (single dose) Toxicity Test		Yes[2]	**Complete**
OECD Guidance Document 239 - Larval Honey Bee Chronic Oral (LCO) (repeat dose) Toxicity Test		Yes[2]	**Complete**
OECD Test Guideline 245 - Honey Bee Adult Chronic Oral (ACO) (repeat dose) Toxicity Test		Yes[2]	**Complete**
850.3030 - Honey Bee Toxicity of Residues on Foliage		No[1]	**Not Triggered**
OECD Guidance Document 75- Honey Bee Colony Brood Test (Enclosure Study) Under Semi-field Conditions		No[1,2]	**Not Triggered**
Non-guideline Field Trial of Residues in Pollen/Nectar		No[1,2]	**Not Triggered**
Non-guideline Semi-field Colony Feeding Study (Oomen *et al.* 1992)		No[1,2]	**Not Triggered**
850.3040 - Field Testing for Pollinators		No	**Not Triggered**

NA =Not Applicable

[1] Per 40 CFR Part 158, specified conditions that require the study are not met.

[2] See EFED guidance on exposure and effects testing for assessing risk to bees. (https://www.epa.gov/sites/default/files/2016-07/documents/guidance-exposure-effects-testing-assessing-risks-bees.pdf)

Table 1-5. Cyclobutrifluram Non-Target Plant Protection Data Requirements to Support Section 3 New Active Ingredients.

Guideline Number - Study Type		Required	Data Requirement Status
Terrestrial and Wetland Plant Toxicity			
850.4100 - Seedling Emergence and Seedling Growth	Tier 1	Yes	**Complete**
	Tier 2	Yes	**Complete**
850.4150 - Vegetative Vigor	Tier 1	Yes	**Complete**
	Tier 2	Yes	**Complete**
850.4230 – Early Seedling Growth Toxicity Test		No[1]	**Not Triggered**
850.4300 - Terrestrial Plants Field Study		No[1]	**Not Triggered**
Aquatic Plant and Algae Toxicity			
850.4025 - Target Area Phytotoxicity		No[1]	**Not Triggered**
850.4400 - Aquatic Plant Toxicity Test Using *Lemna spp*	Tier 1	Yes	**Complete**
	Tier 2	Yes	**Complete**
850.4450 - Aquatic Plants Field Study		No[1]	**Not Triggered**
850.4500 - Algal Toxicity Test		Yes	**Complete**
850.4550 - Cyanobacteria (*Anabaena flos-aquae*) Toxicity Test		Yes	**Complete**

NA =Not Applicable
[1] Per 40 CFR Part 158, specified conditions that require the study are not met.

Table 1-6. Cyclobutrifluram Environmental Fate Test Data Requirements to Support Section 3 New Active Ingredients.

Guideline Number & Study Type		Required	Data Requirement Status
835.2120 – Hydrolysis		Yes	**Complete**
835.2240 - Photodegradation in Water		Yes	**Complete**
850.2410 - Photodegradation in Soil		Yes	**Complete**
835.2370 - Photodegradation in Air		No[1]	**Not Triggered**
835.4100 - Aerobic Soil		Yes	**Complete**
835.4200 - Anaerobic Soil		Yes	**Complete**
835.4300 - Aerobic Aquatic		Yes	**Complete**
835.4400 - Anaerobic Aquatic		Yes	**Complete**
835.1230 - Batch Equilibrium		Yes	**Complete**
835.1240 - Column Leaching		No[1]	**Not Triggered**
835.1410 - Volatility Laboratory		No[1]	**Not Triggered**
835.8100 - Volatility Field		No[1]	**Not Triggered**
835.6100 - Terrestrial Field Dissipation		Yes	**Complete**
835.6200 - Aquatic Field Dissipation		No[1]	**Not Triggered**
835.6300 - Forestry Dissipation		No[1]	**Not Triggered**
835.7100 – Prospective Groundwater Monitoring		No[1]	**Not Triggered**
850.6100 – Environmental Chemistry Method/ Independent Laboratory Validation	Soil (supports 835.6100 and monitoring)	Yes	**Complete**
	Water (supports monitoring)	Yes	**Complete**
	Sediment (supports monitoring)	No[1]	**Not Triggered**

Guideline Number & Study Type		Required	Data Requirement Status
Storage Stability	Soil (supports 835.6100)	Yes	**Complete**
	Water (supports 835.6200)	No[1]	**Not Triggered**
	(supports 835.6300, 835.6400, and/or 835.7100)	No[1]	**Not Triggered**
835.6400 - Combination and Tank Mixes		No[1]	**Not Triggered**

NA =Not Applicable

[1] Per 40 CFR Part 158, specified conditions that require the study are not met.

2 Introduction

This new chemical assessment examines the potential ecological risks associated with proposed labeled uses of cyclobutrifluram on non-target organisms including non-listed and federally listed threatened and endangered non-target organisms. New chemical assessments use the best available scientific information on the use, environmental fate and transport, and ecological effects of cyclobutrifluram. The general risk assessment methodology for non-listed species is described in the *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs* ("Overview Document") (USEPA, 2004a). The methodology for assessing risk to listed species is detailed in this document. Additionally, the process is consistent with other guidance produced by the Environmental Fate and Effects Division (EFED) as appropriate. When necessary, risks identified through standard risk assessment methods are further refined using available models and data. This risk assessment incorporates the available exposure and effects data and most current modeling and methodologies.

2.1 Description of the Action

2.1.1 Mode of Action for Target Pests

Cyclobutrifluram is a Group N-3 nematicide and Group 7 fungicide, similar to fluopyram (PC Code: 080302), belonging to the chemical groups pyridinyl-ethyl-benzamides, phenethyl pyridineamides[13], and phenyl-cyclobutyl-pyridineamide[14]. It is reported as systemic in the product labels, and the mode of action works through disruption of mitochondrial complex II by action as a succinate-coenzyme Q reductase and by inhibiting succinate dehydrogenase which ultimately affects respiration.

[13] https://irac-online.org/documents/nematicides-moa-classification/?ext=pdf

[14] https://www.frac.info/frac-teams/working-groups/sdhi-fungicides/information

2.1.2 Proposed Label and Use Characterization

2.1.2.1 Label Summary

Cyclobutrifluram is a nematicide/fungicide proposed for use to control parasitic nematodes and soil-borne and foliar fungal diseases affecting agricultural crops (romaine lettuce, soybean, and cotton), turf, and ornamentals. The applicant, Syngenta, proposed one technical product and 4 end-use products for registration in the United States. Proposed uses including application rates and timing are summarized in **Table 2-1**.

The following labels are proposed for use on the following sites:

- A22011 T&O (Trefinti®, Trefinti® Flora, Trefinti® TL) for use on turf and ornamentals
- A22417 ST (Victrato™), for use on cotton and soybean seed
- A23156 Crop and A22011 Crop for use on romaine lettuce

Cyclobutrifluram A23156 Crop is a suspension concentrate (SC) containing 25.6% cyclobutrifluram active ingredient (ai) proposed to be applied to romaine lettuce for control of many nematodes and plant diseases. Applications can be made by ground equipment in a soil surface 7- to 10-inch banded application and via chemigation.

Cyclobutrifluram A22011 Crop is a SC containing 38.5% cyclobutrifluram ai proposed to be applied to romaine lettuce for control of many nematodes and plant diseases. Applications can be made by ground equipment in furrow, drench, shank, drip, or banded soil application prior to transplant and via chemigation.

Cyclobutrifluram A22417 ST is a flowable concentrate proposed to be applied to cotton and soybean seed as a water-based slurry utilizing standard liquid-type commercial seed treatment equipment that provides uniform seed coverage. A22417 is for the control of plant parasitic nematodes as well as seed and seedling blight or damping-off caused by listed seed- and soil-borne Fusarium spp. It also provides suppression of Septoria Brown Spot (*Septoria glycines*), Frogeye Leaf Spot (*Cercospora sojina*) and Target Spot (*Corynespora cassiicola*).

Cyclobutrifluram A22011 T&O is proposed to be registered for control of plant pathogenic nematodes and diseases of

- Ornamental plants and non-bearing (juvenile) fruit and nut trees, vines, and berries produced and grown in greenhouses, nurseries (including shade houses, lath houses, and other outdoor growing structures).
- Evergreen (including conifer) and deciduous tree nurseries, forest nurseries, and Christmas tree farms.
- Residential and commercial landscapes, parks, and interior plantscapes,
- Plants and turfgrasses intended for aesthetic or recreational purposes or climatic modification in or around home lawns, residential dwellings, business and office complexes, shopping complexes, multi-family residential complexes, institutional

buildings, airports, cemeteries, wildlife plantings, parks, playgrounds, schools, day-care facilities, and golf courses.

- For residential turf, the following use restrictions are detailed on the label:
    - "DO NOT apply A22011 T&O when lawn weeds are flowering."
    - "DO NOT allow A22011 T&O to drift to plants that are flowering."

Syngenta voluntarily included multiple conservation measures on the proposed labels to reduce exposures to non-target organisms, including pollinators. **Table 2-1** includes many of the measures that help reduce exposures to non-target organisms. Section VI, c of EPA's proposed decision document[15] includes label language that was added to address non-target ecological risks and update labels to current standards.

[15] https://www.regulations.gov/document/EPA-HQ-OPP-2022-0003-0021

Table 2-1. Summary of the Maximum Labeled Use Patterns for Cyclobutrifluram

Use Site/ Location	Form.	App Type/ Target	App Equip[1]	App Time	Max Single Rate lb a.i./A	Max # App/yr*	Max Annual Rate lb a.i./A/yr*	MRI (d)	PHI (d)	Comments (e.g,. geographic/application timing restrictions, pollinator specific language)[2]
Cotton/ ag	FS	Seed[3]	G	At planting	0.085	1	0.085	NA	NA	▪ This product must be used only by commercial seed treatment facilities or with commercial seed treatment equipment on farm. The use of a hopper-box, planter-box, slurry-box or other seed treatment applications at or immediately before planting is not permitted. ▪ Do not feed or harvest soybean hay, forage, and silage. Do not use for feed, food, or oil purposes. ▪ Cyclobutrifluram treated seed may be planted on the same acres 1 time per year.
Soybean[4]/ ag	FS	Seed[3]	G	At planting	0.083	1	0.083	NA	NA	
Romaine Lettuce/ ag	SC	Soil	G, C	Prior/At Plating	0.089	1	0.089	NA	NA	▪ Not for residential use. ▪ Do not apply through any ultra-low volume (ULV) spray system. ▪ For chemigation, do not apply until after crop emergence in direct-seeded crops. ▪ Not for plants grown for transplanting purposes. ▪ Not for greenhouse use unless otherwise specified in the specific crop directions for use table.

Use Site/ Location	Form.	App Type/ Target	App Equip[1]	App Time	Max Single Rate lb a.i./A	Max # App/yr*	Max Annual Rate lb a.i./A/yr*	MRI (d)	PHI (d)	Comments (e.g,. geographic/application timing restrictions, pollinator specific language)[2]
Turf/ Sod-farm, Residential, Golf Course[5]	SC	Foliage	G	All[6]	0.22	2	0.45	14	NA	▪ 0.0051 lb a.i./1,000 sq ft for spot treatments on turf. A minimum of 1 gallon of spray solution/1000 sq ft is recommended for spot treatments on turf. ▪ 0.22 lb a.i./10,000 sq ft per acre per year for spot treatments on Golf Course Greens, Tees, and Fairways. Treat no more than 10,000 sq ft per acre per year. • Do not use for commercial grass seed production. • Do not apply this product aerially. ▪ Do not apply by chemigation to turf. ▪ Do not apply to fruit and nut trees, vines, or berry plants that will bear harvestable fruit within 12 months. ▪ DO NOT apply when lawn weeds are flowering. ▪ DO NOT allow to drift to plants that are flowering.
Ornamentals (Nursery)/ outdoor or indoor	SC	Soil/ Container	G, C	All[6]	0.187	2	0.374	14	NA	

Abbreviations: Form.= formulation; App= application; equip=equipment; a.i.= active ingredient; MRI= minimum retreatment interval; d= day; PHI= preharvest interval; Ag= agricultural; FS= flowable soluble for seed treatment; G= ground; SC= soluble concentrate; C= chemigation.

* Information is provided on an annual basis, unless otherwise specified.

[1] The labels for ornamentals and romaine state that ground applications can be made by container drenches and broadcast, banded, and directed sprays using application equipment typically used for ground applications, such as, but not limited to, Hydraulic boom sprayers, Mechanically pressurized hand-guns, Hand-pressurized hand-wand sprayers, Backpack sprayers, Irrigation for soil applications. Specific application method instructions for romaine lettuce are: “Apply using one of the following application methods: in furrow, drench, shank, drip, or banded soil application prior to transplant.”

[2] Based on statements in the proposed labels, the applicant is considering not registering proposed uses of cyclobutrifluram in California (all uses) and New York (cotton statewide; turf and ornamentals in specific counties); however, those statements are not currently a requirement on the proposed labels.

[3]Seed = seed treatment. Maximum Annual Application rate for uses on A22417 Seed Treatment label pertains to use of all cyclobutrifluram-containing products through any combination of seed and foliar applications, but only seed treatment uses are permitted for cotton and soybean. An analysis of the range of seeding rates recommended across the US for cotton and soybeans confirmed that the high end of the effective per acre application rate approaches the

maximum annual rate on the proposed label for these crops (with only one cyclobutrifluram application via a seed treatment is allowed annually). See: USEPA (2011a).

[4] There may be slight discrepancies between some of the annual applications rates assessed for soybean in this document and those listed in the use table, as this assessment was completed using the initial product labels. Proposed use labels were updated close the publication date of the draft assessment and proposed decision document. There were slight changes to maximum application rates for soybean seed treatments, but those changes do not alter the overall risk conclusions of this assessment.

[5] Turfgrass grown on sod farms; including plants and turfgrasses intended for aesthetic or recreational purposes or climatic modification in or around home lawns, residential dwellings, business and office complexes, shopping complexes, multi-family residential complexes, institutional buildings, airports, cemeteries, wildlife plantings, parks, playgrounds, schools, day-care facilities, golf courses, athletic fields, and other landscaped areas. For spot treatments on golf course, greens, tees, and fairways apply 0.11 lb ai per 10,000 sq ft and repeat up to 4 times a year at the prescribed intervals or apply 0.22 lb ai per 10,000 sq ft and repeat up to 2 times a year at the prescribed intervals.

[6] All= indicates that the product may be applied during any crop status. Typically, this occurs when the product is applied based on pest pressure.

2.2 Analysis Plan

2.2.1 Overall Process

This ecological risk assessment of the proposed registration of the active ingredient cyclobutrifluram follows a stepwise approach to determine potential risks to non-listed and listed (threatened or endangered) species. Assessment begins with evaluating potential risk concerns at the taxon-level to identify risk to non-listed species and to help focus species-specific assessment of listed species. Risks of concern identified at the taxon-level for listed species and designated critical habitats are further evaluated through analysis of species-specific considerations. This section will discuss each step for a brief introduction to the process. More detailed explanations of the steps will be provided in their respective sections of this document.

Under the Endangered Species Act (ESA), it is the obligation of the Environmental Protection Agency (EPA), in consultation with the Services (includes the Fish and Wildlife Service [FWS] and the National Marine Fisheries Service [NMFS]), to ensure the registration of cyclobutrifluram is not likely to jeopardize the continued existence of threatened or endangered species nor adversely modify any designated critical habitat. Therefore, in conjunction with the counterpart regulations for FIFRA actions (**Section 3**), assessment of the likelihood that an action will adversely impact listed species or designated critical habitats are included in EPA's biological evaluation with effects determinations (**Section 4**) for this new chemical registration.

2.2.1.1 Taxon-Level Assessment and RQ comparisons to Endangered Species LOC

The first step of the assessment uses a weight of evidence approach that relies heavily, but not exclusively, on a risk quotient (RQ) method. RQs are calculated by dividing an estimated environmental concentration (EEC) by a toxicity endpoint (*i.*e., EEC/toxicity endpoint). This is a way to determine if an estimated concentration is expected to be above or below the concentration associated with the effects endpoint. The RQs are compared to regulatory levels of concern (LOCs). For acute risks to listed and non-listed aquatic vertebrates and invertebrates, the LOCs are 0.05 and 0.5, respectively. For acute risks to listed and non-listed terrestrial vertebrates, the LOCs are 0.1 and 0.5, respectively. The acute LOCs for listed and non-listed terrestrial invertebrates are 0.05 and 0.4, respectively. The LOC for plants and chronic exposures to all other taxa, both listed and non-listed, is 1.0.

Potential risk of concern is indicated when the LOCs are exceeded by the RQ values. RQ exceedances will result in more refined modeling and characterization for additional clarity on potential risks attributed to cyclobutrifluram exposure.

2.2.1.2 Species Range and Critical Habitat Overlap and Exposure/Deterministic Analysis

In assessing effects to listed species, potential effects to listed species and designated critical habitats (CHs) resulting from cyclobutrifluram registration are evaluated. Effects determinations are based on both direct effects (survival, growth, and reproduction) and indirect impacts to prey, pollination, habitat, and/or dispersal (PPHD). At this step of the assessment and continuing into the next step, the evaluation process becomes more spatially focused. An analysis is completed to determine potential overlap between cyclobutrifluram use sites and individual species ranges and critical habitats. Tools to calculate potential overlap[16] are used for the analysis for increased efficiency. For uses where overlap is detected, species dietary items and habitat data are utilized to determine potential impacts to listed species on a more species-specific basis.

For this part of the assessment process, potential for adverse effects to listed species and critical habitats is evaluated in stages. In the first stage, it is determined whether the use of cyclobutrifluram will have no effect (NE) or may affect (MA) a listed species or designated CH. If an MA determination is found for one or more listed species, an obligation to consult with the Services (FWS and NMFS), based on Services' regulations, is triggered.

In the next stage, any MA determinations in the first stage are further evaluated to determine whether cyclobutrifluram use "may affect but is not likely to adversely affect" (NLAA) or "may affect and is likely to adversely affect" (LAA) each species or designated CH. NLAA determinations are made when species-specific information or spatial refinements indicate the proposed action would lead to discountable exposure or insignificant effects for a given listed species or designated CH. When LAA determinations are made, the likelihood that cyclobutrifluram may lead to jeopardy of a listed species and adverse modification of a critical habitat (J/AM) is assessed.

2.2.2 Modeling

Various models are used to calculate aquatic and terrestrial EECs (see **Table 2-2).** The specific models used in this assessment are discussed further below.

Table 2-2. List of the Models Used to Assess Risk

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates (including sediment dwelling)	Surface water and sediment[1]	Runoff and spray drift to water and sediment	PWC version 2.001[2]

[16] https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#overlap

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Terrestrial	Vertebrate	Dietary items	- Dietary residues from liquid sprays (includes residues on foliage, seeds/pods, arthropods, and soil) - Ingestion of Seeds	T-REX version 1.5.2[3] -Kenaga nomogram (for liquid sprays) - ingestion of treated seeds calculations
		Consumption of aquatic organisms	Residues taken up by aquatic organisms	KABAM version 1.0[4]
	Bees and other terrestrial invertebrates	Contact Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	BeeREX version 1.0 T-REX version 1.5.2[3]
All Environments	Plants (Aquatic and Terrestrial)	Spray drift/runoff	Runoff and spray drift to terrestrial, wetland, and aquatic plants	PAT version 2.8[5]
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift [Spray drift is generally not applicable to seed treatments] (USEPA, 2012)	AgDRIFT version 2.1.1 (Spray drift)

[1] Sediment analysis is recommended when the soil-water distribution coefficient (Kd) ≥50-L/kg-soil; the log K_{OW}≥3; or the K_{OC} ≥ 1000 L/kg-organic carbon. Analysis of risk in sediment from exposure in pore water may also occur if aquatic invertebrates are particularly sensitive, as it is expected that RQs will exceed LOCs even if the sediment is not the primary exposure media.

[2] The Pesticide in Water Calculator (PWC) is a Graphic User Interface (GUI) that estimates pesticide concentration in water using the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM).

[3] The Terrestrial Residue Exposure (T-REX) Model is used to estimate pesticide concentration on avian, mammalian, and listed terrestrial invertebrate food items. For liquid applications to bare soil, arthropod and seed residues estimated from the Kenaga nomogram are possible dietary exposure routes on the field and foliar residues estimate exposure adjacent to the field and that may occur with spray drift.

[4] The K_{OW} based Aquatic Bioaccumulation Model (KABAM) is used to estimate exposure to terrestrial animals that may consume aquatic organisms when a chemical has the potential to bioconcentrate or bioaccumulate. The general triggers for running this model are that: the pesticide is a non-ionic, organic chemical; the Log K_{OW} value is between 3 and 8; and the pesticide has the potential to reach aquatic habitats.

[5] The Plant Assessment Tool (PAT) is a mechanistic model that incorporates environmental fate and transport data to estimate pesticide concentrations in terrestrial, wetland, and aquatic plant habitats. PAT uses exposure estimates generated in the Pesticide in Water Calculator (PWC) version 2.001 and spray drift estimates from AgDRIFT® to calculate terrestrial, wetland, and aquatic exposures and risk quotients.

3 Taxon-Level Risk Assessment

3.1 Residues of Concern

In selecting the residues of concern for ecological exposure and risk assessment, both exposure (magnitude/timing) and toxicity of parent and associated residues were considered.

Ecological exposure of concern is determined to be associated with parent cyclobutrifluram. Parent degrades slowly in the environment for most dissipation pathways in most conditions. Aerobic soil, aerobic aquatic, and anaerobic aquatic ASM degradation half-lives range from 150 to 1097, 713 to 776, and 676 to 1230 days, respectively. The aqueous photolysis half-live is shorter at 23.4 days, but photolysis contributes less to the overall environmental fate of pesticides and the photolysis half-life would have to be significantly shorter than it is to contribute significantly to the overall environmental exposure to cyclobutrifluram degradates.

The analysis of the toxicity of the degradates is in **Section 3.2.2**. ECOSAR Analysis and limited toxicity studies for the degradate SYN510275 supports the expected lower toxicity of potentially major degradates (occuring at maximum concentrations exceeding 10% of applied cyclobutrifluram). The major degradates are generally, one or more orders of magnitude less toxic. Please refer to **Appendix B** for the chemical identity and summaries of occurrence in the environmental fate studies of these degradates. Combined with predominance of environmental exposure expecting to be to parent this supports the inclusion of parent alone in the residues of concern.

3.2 Environmental Fate Summary

3.2.1 Parent Fate and Transport

Cyclobutrifluram is persistent (Classification of Goring, 1975) in soil and water (the aerobic soil metabolism half-lives range from 198 to 1097 days and aerobic and anaerobic aquatic metabolism half-lives are 713 - 776 and 677 - 1230 days, respectively), further details are in **Table 3-2**. Cyclobutrifluram is not subject to hydrolysis at any pH tested.

Parent transportation to surface waters via runoff and erosion can contribute to acute and chronic exposure. The potential for leaching to groundwater can be significant with long term use where vulnerable aquifers are present, as indicated by K_{OC} values from 301 to 643 L/kg (**Table 3-1**). The Koc values are in the moderately mobile range according to the FAO (2000) classification. The potential for leaching to groundwater was sporadically observed for parent cyclobutrifluram in the submitted terrestrial field dissipation studies (**Table 3-3**). Degradates were on occasion measured at major concentrations in fate studies, however, study durations prohibited the determination of their degradation kinetics.

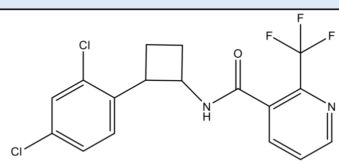
In general, bound, unextracted residues did not accumulate to >20% of applied in the fate studies. In the aerobic soil metabolism studies unextracted residues ranged at study termination from 4 to 13% of the applied radioactivity in five ^{14}C-pyridinyl labeled soils and were 21% in one ^{14}C-phenyl radiolabeled test soil (**Appendix B**). Unextracted residues at study termination were 5 – 8%, 14 – 27%, and 7 – 8% in the aerobic aquatic, anaerobic soil, and anaerobic aquatic tests. The aerobic soil samples were extracted using solvents with a range of dielectric constant (including non-polar solvents). Parent cyclobutrifluram remained the dominant residue detected throughout the course of these studies.

Volatilization in the environment is expected to negligible given the vapor pressure <4.65E-8 torr, solubility of 33 ppm, and calculated Henry's law constant of 3.12 E-8 (unitless) see **Table 3-1** and EPA (2015a).

The octanol-water partition coefficient (K_{OW}) is 3.2 and the mean K_{oc} or K_{foc} values of 410 and 376 ml/g, respectively, are marginally within the range of values that would trigger the need to conduct a separate sediment exposure assessment (40 CFR Part 158.630).[17] Per EFED policy, compounds with a log K_{OW} of three and above are routinely evaluated for the potential to bioconcentrate in aquatic organisms. The measured bioconcentration factor (BCF) is 31 L/kg-wet weight and 97% depuration by day 14 after exposure (**Table 3-1**).

Photolysis of cyclobutrifluram does occur with estimated half-lives of 30 days in soil and 12 to 23 days in water at 40°N latitude (**Table 3-2**).

Table 3-1. Physical and Chemical Properties for Cyclobutrifluram

Parameter	Value	Source / (Classification)/ Comment [4]
Chemical Structure	 There are two different main descriptions of the racemic / enantiomer mixture of the parent compound as follows. 1. According to the submitted environmental fate studies the active ingredient consists of a mixture comprised of 80–100% N-[(1S,2S)-2-(2,4-dichlorophenyl)cyclobutyl]-2-(trifluoromethyl)nicotinamide and 20–0% of the (1R,2R)-enantiomer.	MRID 51460220 [18] (NA)

[17] Sediment data may be required if the soil-water distribution coefficient (K_d) is ≥ 50 L/kg, K_{OC}s are ≥1000 L/kg-organic carbon, or the log K_{OW} is ≥ 3 (40 CFR Part 158.630). Sediment data may also be requested if there may be a toxicity concern.
[18] See also:
Syngenta Crop Protection, LLC. 2021. Cyclobutrifluram (SYN549522). Document m-ii, section 5: fate and behaviour in the environment.

<table>
<tr><th>Parameter</th><th colspan="5">Value</th><th>Source / (Classification)/ Comment [4]</th></tr>
<tr><td></td><td colspan="5">2. According to a separate summary document of the registrant’s environmental fate studies, In the registrant’s naming system, SYN549522, the active ingredient, consists of a mixture of 2 stereoisomers SYN547386 and SYN548941.
The test material which consisted of >90% of the S, S isomer of SYN549522 (SYN547386) and <10% of the R, R isomer (SYN548941). Neither of the trans isomers (S, R or R, S) were present.</td><td></td></tr>
<tr><td>Molecular Weight (g/mole)</td><td colspan="5">389.2</td><td>MRID 51459902
(NA)</td></tr>
<tr><td>Water (pure) Solubility Limit at 20^{o}C (mg/L)</td><td colspan="5">33 for PAI[3]
18 for TGAI[3]</td><td>MRID 51459902
(A)</td></tr>
<tr><td>Vapor Pressure at 20°C (torr)</td><td colspan="5">< 4.65E-8
(< 6.2 x 10-6 Pa)</td><td>MRID 51459902
(A)</td></tr>
<tr><td>Henry’s Law Constant at 20^{o}C (unitless)</td><td colspan="5">3.12 E-8
(Registrant calculated value was < 7.3. E-5 Pa m³ / mol)</td><td>Calculated[1]
(NA)</td></tr>
<tr><td>Log Dissociation Constant (pKa)</td><td colspan="5">No pKa was observed in the pH range of 2 to 12.0 by spectrophotometric analysis of a solution of cyclobutrifluram in water</td><td>MRID 51459902
(A)</td></tr>
<tr><td>Octanol-water Partition Coefficient (K_{OW}) at 20^{o}C (unitless)</td><td colspan="5">1706.01 (log K_{OW} = 3.2)</td><td>MRID 51459902
(A)</td></tr>
<tr><td rowspan="11">Soil-Water Distribution Coefficients (K_d) or Freundlich Coefficient (K_F)

Organic Carbon-Normalized Distribution Coefficients (K_{OC}) or Freundlich Coefficients (K_{FOC})</td><th>Soil</th><th>K_{oc} (L/kg-OC)</th><th>K_d (L/kg-soil)</th><th>K_F ((L/kg-soil)$^{-1/n}$)</th><th>K_{Foc} ((L/kg-OC)$^{-1/n}$)</th><td rowspan="11">MRID 51460215
(A)

According to the McCall (1981) Classification scale to assess a chemical’s potential mobility in soil (based on its K_{Foc}), cyclobutrifluram can be classified as having a low to medium potential mobility

Moderately Mobile according to the FAO (2000) Classification</td></tr>
<tr><td>Sand</td><td>643</td><td>3.73</td><td>3.32</td><td>572</td></tr>
<tr><td>Sandy clay loam</td><td>405</td><td>7.66</td><td>7.32</td><td>387</td></tr>
<tr><td>Loam</td><td>338</td><td>7.03</td><td>6.32</td><td>304</td></tr>
<tr><td>Silt loam</td><td>301</td><td>6.80</td><td>6.41</td><td>284</td></tr>
<tr><td>Clay loam</td><td>465</td><td>4.00</td><td>3.63</td><td>422</td></tr>
<tr><td>Sandy loam</td><td>306</td><td>6.52</td><td>6.10</td><td>286</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mean</td><td>410</td><td>5.96</td><td>5.52</td><td>375.83</td></tr>
<tr><td>Std Deviation</td><td>130.55</td><td>1.67</td><td>1.64</td><td>111.71</td></tr>
<tr><td>Coefficient of Variation (%)</td><td>31.87</td><td>27.96</td><td>29.70</td><td>29.72</td></tr>
<tr><td rowspan="2">Fish Bioconcentration Factor (BCF) (L/kg-wet weight fish)</td><th>Species</th><th colspan="2">BCF</th><th colspan="2">Depuration</th><td rowspan="2">MRID 51459430
(S)
Based on total residues[2]</td></tr>
<tr><td>Bluegill sunfish (Lepomis macrochirus)</td><td colspan="2">31 (whole fish)</td><td colspan="2">97% by Day 14</td></tr>
</table>

[1] All estimated K_{AW} values were calculated according to “*Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk*

Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments" (USEPA, 2010).
[2] The majority of recovered radioactivity was identified as parent.
[3] TGAI = Technical grade of the active ingredient; PAI = Pure active ingredient.
[4] A = Acceptable, S = Supplemental, NA = Not applicable.

Table 3-2. Summary of Environmental Degradation Data for Cyclobutrifluram

Study	**System**	**Observed DT50 and DT90 (days), respectively[6]**	**Calculated Half-life (days)[1]**	**MRID Source (Study Classification)/ Comment[2]**
Abiotic Hydrolysis[3] (50°C+)[1]	pH 4	NA	Stable	51460222 (A)
	pH 7	NA	Stable	
	pH 9	NA	Stable	
Soil Photolysis (20°C)	pH 7	25 to 35 >35	29.6	51460205 (S)
Aqueous Photolysis (25°C)	pH 7	13 to 29 DT50 >29 DT90; 7 to 14 DT50 20 to 31 DT90	<u>23.4[4]</u> (^{14}C-pyridinyl); 11.5 (^{14}C-pyridinyl)	51460223 (S)
Aerobic Soil Metabolism[5] (20°C)[3] (Study with 14C pyridinyl label unless otherwise specified.) Studies were supplemental primarily due to incomplete characterization of degradates.	18 Acres UK sandy clay loam pH 5.7, OC 1.89%	>120 >120	619 (SFO)	51460201 (S)
	East Anglia UK, sandy loam pH 7.6, OC 2.12%	>120 >120	445 (DFOP)	51460201 (S)
	Gartenack, Switz., silt loam pH 7.5, OC 2.25%; ^{14}C pyridinyl label	>120 >120	245 (SFO)	51460201 (S)
	Gartenack, Switz., silt loam pH 7.5, OC 2.25%; ^{14}C phenyl label	>125 >125	150 (SFO) Used mean, 2 **labels = 198**	51460202 (S)
	Sarpy, NE, loam pH 6.9, OC 2.07%	>120 >120	986 (SFO)	51460201 (S)
	Capay CA, clay loam pH 7.7,	>120 >120	1097 (SFO)	51460201 (S)

Study	System	Observed DT50 and DT90 (days), respectively[6]	Calculated Half-life (days)[1]	MRID Source (Study Classification)/ Comment[2]
	20 °C, OC 0.86%			
Aerobic Aquatic Metabolism (20°C) Calculated from combined results of separate tests with phenyl-U-^{14}C]- and [pyridinyl-2-^{14}C]-labeled parent with both test systems. Study is supplemental primarily due to incomplete characterization of degradates.	Calwich Abbey Lake UK, Silt Loam; water pH 8.1, sediment pH 7.6	>101 >101	713 (SFO)	51460220 (S)
	Golden Lake ND, sand; water pH 8.3, sediment pH 8.1 EOS = 101 d	>101 >101	776 (SFO)	51460220 (A)
Anaerobic Aquatic Metabolism (20°C) Calculated from combined results of separate tests with phenyl-U-^{14}C]- and [pyridinyl-2-^{14}C]-labeled parent with both test systems.	Calwich Abbey Lake UK, Silt Loam, pH 8.1, sediment pH 7.6)	>100 >100	676 (SFO)	51460219 (A)
	Golden Lake North Dakota, US Water:sand sediment (20�C, water pH 8.3, sediment pH 8.1)	>100 >100	1230 (SFO)	51460219 (A)
Anaerobic Soil Metabolism (20°C) (Study with ^{14}C pyridinyl label unless otherwise specified.)	18 Acres UK sandy clay loam pH 5.7, OC 1.89%	>122 >122	884 (SFO)	51460204 (A)
	East Anglia UK, sandy loam pH 7.6, OC 2.12%	>122 >122	349 (SFO)	51460204 (A)
	Gartenack, Switz., silt loam pH 7.5, OC 2.25%; ^{14}C combined labels	>122 >122	570 (SFO)	51460204 (A)

Study	System	Observed DT50 and DT90 (days), respectively[6]	Calculated Half-life (days)[1]	MRID Source (Study Classification)/ Comment[2]
	Sarpy, NE, loam pH 6.9, OC 2.07%	>122 >122	288 (SFO)	51460204 (A)
	Capay CA, clay loam pH 7.7, 20 °C, OC 0.86%	>122 >122	379 (SFO)	51460204 (A)

[1] SFO=single first order; DFOP=double first order in parallel; IORE=indeterminate order (IORE); SFO DT_{50}=single first order half-life; tR_{IORE}=the half-life of a SFO model that passes through a hypothetical DT_{90} of the IORE fit; DFOP slow DT_{50}=slow rate half-life of the DFOP fit, --=not available or applicable; SFO-LN=SFO calculated using natural log transformed data. The value used to estimate a model input value is the calculated SFO DT_{50}, T_{IORE}, or the DFOP slow DT_{50} from the DFOP equation. The model chosen is consistent with EPA guidance (NAFTA, 2012).

[2] A = Acceptable, S = Supplemental, U = Unacceptable.

[3] The hydrolysis studies were only done at 50, 60 and 70°C and the loss of parent over the course of the 30-day studies was usually < 2% (<5% for [pyridinyl-2-^{14}C] at pH 4 and 9.

[4] Recommended aqueous photolysis value for environmental fate modeling, adjusted for 12-hours of sunlight per day at 40° N latitude.

[5]Although adequate characterization of parent cyclobutrifluram decline was provided in the MRID 51460201 and 514960202 studies, degradates were not sufficiently characterized and parent degradation was limited over the course of the study. Additional information on the degradates formed is provided in a non-guideline intact soil core aerobic metabolism study, which is supplemental. (The data are valid, but the study conditions are not as specified for an 835.4100 study) and provides more detailed accounting of the aerobic soil metabolism pathway.

[6] DT = Disappearance time. This is a point in time or interval in time in which 50 or 90% loss of the applied cyclobutrifluram occurred (DT50 or DT90, respectively).

Cyclobutrifluram initially dissipated from the soil profile in the field by more than 50% in the first few months after application in the field studies but the estimated time to 90% dissipation extended beyond the length of the studies and was estimated to be several months to several years (**Table 3-3**). This suggests that some of the initial dissipation may have been due to various transport mechanisms rather than degradation. Degradates that formed at maximum 5% or more of the applied cyclobutrifluram were:

- SYN510275 at maximum percent applied ranging from 2 to 14% of applied cyclobutrifluram at 9 test sites.
- CGA177291 at maximum percent applied ranging from 0.1 to 11% of applied cyclobutrifluram at 4 test sites.
- SYN549104 at maximum percent applied ranging from 0.4 to 10% of applied cyclobutrifluram at 11 test sites.

Residues of parent cyclobutrifluram were detected in the lowest depth (70-100 cm) in one or more samples in 5 of 8 of the field dissipation studies. This supports the analysis that cyclobutrifluram has potential to leach to groundwater in some environments. While field dissipation studies are designed to capture a range of loss processes; laboratory studies are designed to capture loss from one process (e.g., hydrolysis, aerobic metabolism, etc.). Thus, the values from laboratory studies are not directly comparable to the values from the field studies; however, it is informative to have some understanding of how the laboratory data compares to the loss rates in the field dissipation studies. There were generally only low levels of degradates detected in the field studies as described further in the following section.

Table 3-3. Fate of Cyclobutrifluram in Field Dissipation Studies

System Details[1]	Observed Parent Dissipation Value[2]		Modeled Total Soil Profile[1]		Deepest Soil Layer Detection (cm)	Source MRID
	DT50 (days)	DT90 (days)	DT50 (days)	DT90 (days)		
Ontario, Canada bare plot **Loam** **pH 7.1** **EOS = 486d**	14-49	>485	25.5 (IORE)	13600 (IORE)	70-100	51460208 (A)
Georgia bare plot **Sand** **pH 7.0** **EOS = 540d**	28-120	>365	64.5 (DFOP)	654 (DFOP)	70-100	51460209 (A)
Georgia peanut crop **Sand** **pH 7.0** **EOS = 540d**	28-120	>365	60.5 (IORE)	396 (IORE)	20-40	51460209 (A)
Georgia **Turf plot** **(Grass+thatch+soil)** **Sand** **pH 6.7** **EOS = 553d**	28-90	267-358	69.2 (IORE)	413 (IORE)	15-30	51460213 (A)
California **Turf plot** **Loamy sand** **pH 8.1** **EOS = 558d**	28-61	271-362	86.8 (SFO)	234 (SFO)	30-45	51460212 (A)
Washington **Bare plot** **Sand** **pH 8.3** **EOS = 545 d**	63-120	>359	110 (IORE)	694 (IORE)	80-100	51460210 (A)
Washington **Potato crop** **Sand** **pH 8.3** **EOS = 545 d**	63-271	>271	147 (IORE)	1734 (IORE)	80-100	51460210 (A)
California **Bare plot** **Loamy sand** **pH 6.9** **EOS= 539d**	58-90	360-450	103 (DFOP)	544 (DFOP)	80-100	51460211 (A)

System Details[1]	Observed Parent Dissipation Value[2]		Modeled Total Soil Profile[1]		Deepest Soil Layer Detection (cm)	Source MRID
	DT50 (days)	DT90 (days)	DT50 (days)	DT90 (days)		
California Cotton crop Loamy sand pH 6.9 EOS = 539d	90-269	>360	178 (SFO)	591 (SFO)	80-100	51460211 (A)

[1] EOS = End of study in days after the first application of cyclobutrifluram

[2] DT_{50} and DT_{90} values were calculated using nonlinear regression and single first-order (SFO), double first-order in parallel (DFOP), and indeterminate-order equation (IORE). The equations can be found in the document, *Standard Operating Procedure for Using the NAFTA Guidance to Calculate Representative Half-life Values and Characterize Pesticide Degradation*, U.S. Environmental Protection Agency, November 30, 2012.

3.2.2 Degradation Summary

The cyclobutrifluram molecule consists of a cyclo-butyl carboxamide bridge linking a dichlorophenyl and a trifluoromethylpyridinyl ring structure. During the degradation process the bridge between these ring structures is broken and hence further metabolism will occur separately for the phenyl and pyridine ring structures.

There is very little information on metabolites from most of the environmental fate studies due to the high persistence of parent relative to the durations of each of these studies. Nearly all half-life calculations are extrapolated in the sense that much less than 50% of the parent was transformed over the course of the study. It appears that under some environmental conditions SYN510275 and possibly SYN510260 (derivatives of the triflluoromethyl pyridine ring after cleavage of the parent molecule) might form at higher levels. However, this is an uncertainty, and very limited formation was detected in the submitted environmental fate studies after a duration of up to 3 or 4 months. Eventually another degradate, trifluoroacetic acid (TFA) is split from the pyrindyl ring. TFA is a compound formed from many xenobiotics and which may be mobile and persistent in the environment. TFA in available studies has only shown to have effects on various classes organisms at concentrations significantly higher than those expected from the use of cyclobutrifluram (See, for example, Boutonnet et al (1999) and Solomon et al (2016). TFA residues have been shown to be accumulating in California wetlands and found in food and water (Jordan and Frank, 1999; Scheurer et al., 2017; Scheurer and Nödler, 2021). Another degradate CGA177291 (2,4-Dichlorobenzoic acid) that is a derivative of the 2,4-dichlorophenyl ring was found to be a major product in a single field dissipation study (also detected at much lower levels at three other field dissipation sites) and the soil photolysis study.

3.2.2.1 Metabolism in Soil and Water

A summary of the aerobic soil metabolism pathway is found in **Figure 1**. Only 7 to 36% of cyclobutrifluram was transformed at study termination in five test soils in the aerobic soil metabolism studies (**Table 3-2**; MRID 51460201 and 51460202). The following degradates were detected at 5% in one or more test system in 835.4100 studies or a supplemental nonguideline study, see Table 4 for details:

- TFA – Up to 11% in one test soil of an 835.4100 study aerobic soil metabolism study
- SYN510275 - Up to 7 to 19% in three test soil systems in the supplemental nonguideline study of metabolism in soil columns (MRID 51460203)
- Combined SYN510275 and SYN510260 (Not separately analyzed samples) – Up to 8 to 24% in three test soil systems in the supplemental nonguideline study.

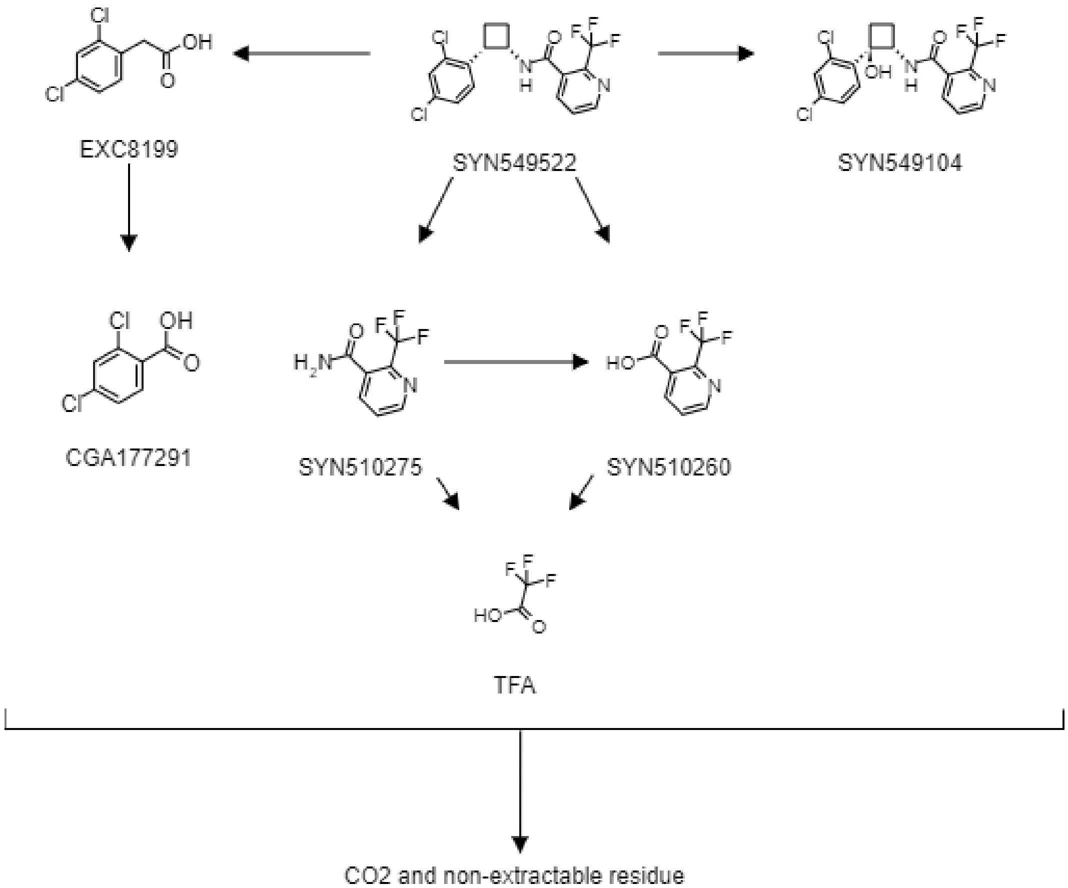


Figure 1. Proposed Metabolic Pathway of Cyclobutrifluram in Soil.

In the two aerobic aquatic test systems only 10 to 12% of the parent was transformed after 101 days and there were no transformation products formed at >5% of applied **Table 3-2** and **Appendix B Table 1.** In the two anaerobic aquatic metabolism studies only -1 to 9% of the parent was transformed in two test systems after 100 days and there were no transformation products formed at >5% of applied. In the two anaerobic soil metabolism studies only 1.0 to 38% of the parent was transformed in five test systems after 122 days and there were no transformation products formed at >5% of applied cyclobutrifluram.

3.2.2.2 Photodegradation

A proposed pathway for the photodegradation of cyclobutrifluram is provided in **Figure 2.** In the aqueous photolysis and the soil photolysis studies there were major degradates formed by photolytic pathways that were not detected in the other environmental fate studies. The following were unique photo degradates found at >5% of the applied cyclobutrifluram:

- SYN551231 found at up to 39% applied radioactivity in aqueous photolysis.
- SYN551241 found at up to 5% applied radioactivity in aqueous photolysis.

SYN551241 is a highly volatile degradate that might have been detected at higher concentrations but in the available study much of the volatile residues were not successfully trapped. A one-time sample from a follow-up test under non-guideline conditions trapped SYN551241 more efficiently at higher levels (MRID 51460223).

The following degradates were found at >5% of applied in one or more of the photolysis tests and were detected at some level in one or more other fate studies:

- EXC8199 found at 12% in a soil photolysis test (Also found at 0.08% of applied in one field dissipation test)
- SYN510275 found at 37% in an aqueous photolysis test (Also found in a supplemental (soil core) aerobic soil test and several field dissipation studies)

Structural activity analysis with the Ecological Structure Activity Relationships Program (ECOSAR; **Section 3.3.4**) indicates that the aqueous photolysis product, SYN551241 is potentially a more potent toxin to certain organisms than parent cyclobutrifluram. EFED has not found that such unique photodegradation products occur significantly in the environment in field dissipation or aquatic studies for this or other active ingredients. Consequently, it is not possible to calculate an environmental exposure for SYN551241 alone. In spite of the potential toxicity, environmental exposure is not expected to be sufficient to contribute to the overall ecological effects of cyclobutrifluram. There remains an unquantifiable possibility that when cyclobutrifluram reaches surface waters via spray drift or runoff that SYN551241 could occur in shallow clear waters exposed to sunlight.

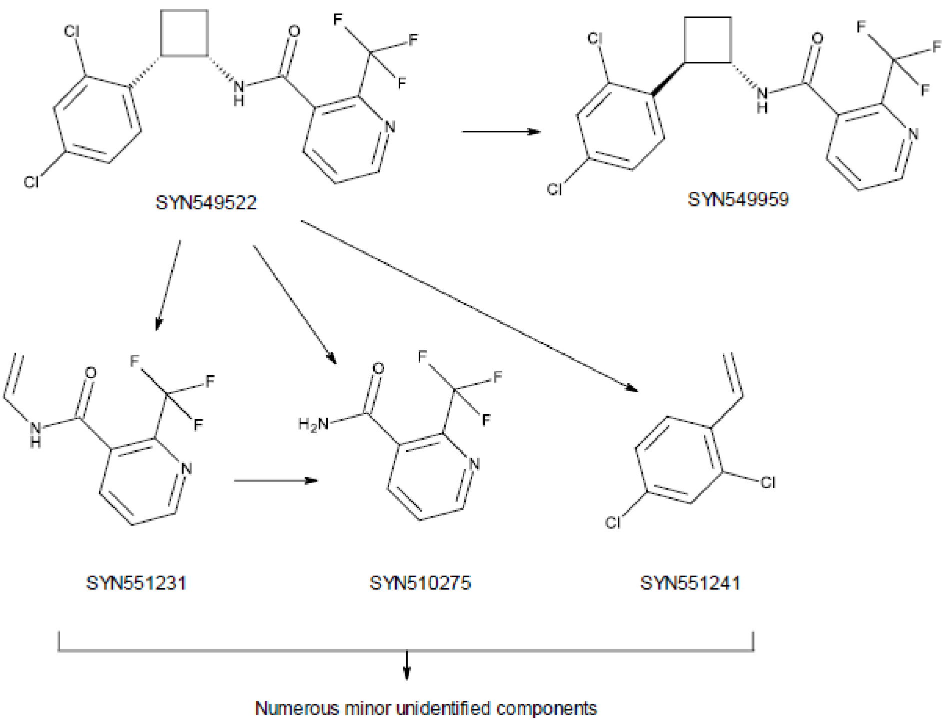


Figure 2. Schematic of the Photolytic Pathway of Cyclobutrifluram

3.3 Ecotoxicity Summary

Ecological effects data are used to estimate the toxicity risk of cyclobutrifluram use based on effects to test species used as surrogates for similar taxa. All available ecotoxicity data for cyclobutrifluram are summarized in **Section 3.3.1**, **Section 3.3.2**, and **Section 3.3.3**. Various studies with terrestrial and aquatic plants, birds, and aquatic animals exposed to either the TGAI or formulated cyclobutrifluram or one metabolite of cyclobutrifluram were received with this registration request; the results of the most sensitive studies are described briefly in this section, full descriptions of all submitted studies can be found in **Appendix E.**

Table 3-4, **Table 3-5, Table 3-6,** and **Table 3-7** summarize the available data for measured toxicity endpoints across taxa. These endpoints are not likely to capture the most sensitive toxicity endpoints for particular taxa but capture the most sensitive endpoints across tested species for each taxa. All studies in these tables are classified as acceptable or supplemental. Non-definitive endpoints are designated with a greater than or less than value. The most sensitive endpoints, those used for assessment purposes, are designated in bold within the tables and described in more detail within the text.

3.3.1 Aquatic Animal Toxicity

The available data indicate that cyclobutrifluram TGAI is slightly toxic to freshwater fish and at most slightly toxic (based on a non-definitive LC_{50}) to estuarine/marine fish on an acute exposure basis. Cyclobutrifluram is at most slightly toxic (based on a non-definitive EC_{50}) to freshwater invertebrates and highly toxic to estuarine/marine invertebrates on an acute exposure basis. SYN510275, a cyclobutrifluram metabolite, is practically nontoxic to freshwater fish and freshwater invertebrates on an acute exposure basis.

Chronic No Observable Adverse Effects Concentrations (NOAECs) for fish and freshwater invertebrates (water-column) are at least an order of magnitude lower than the acute LC_{50}s for those taxa. For estuarine/marine invertebrates (water-column), the acute IC_{50} was about 2X higher than the NOAEC. The most sensitive NOAEC for the freshwater benthic invertebrate was about 0.6X of the freshwater water-column invertebrate NOAEC. The NOAEC for the estuarine/marine benthic invertebrate was at least an order of magnitude higher than the NOAEC for the estuarine/marine water-column invertebrate.

3.3.1.1 Aquatic Vertebrate Studies

Freshwater Fish

In a 96-hour acute toxicity study (MRID 51459425), Fathead Minnows (*Pimephales promelas*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent control), 1,500, 3,300, 7,200, 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 700, 1,500, 3,600, 7,500, and 16,000 µg a.i./L. Based on low recoveries (46%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Mortality was 100% in the highest concentration after 24 hours. The 96-hour LC_{50} was determined to be 11,000 µg a.i./L. This study was classified as acceptable.

In a 96-hour acute toxicity study (MRID 51459424), Fathead Minnows (*P. promelas*) were exposed to SYN510275 (metabolite of cyclobutrifluram) at nominal concentrations of 0 (negative control) and 99,000 µg a.i./L. Mean-measured concentrations were determined to be <1.8 (<LOQ, negative control) and 99,000 µg a.i./L. There were no effects to mortality in the control and treatment groups. The 96-hour LC_{50} was determined to be >99,000 µg a.i./L. This study was classified as acceptable.

In a 32-day early life stage toxicity study (MRID 51459429), Fathead Minnows (*P. promelas*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 130, 320, 800, 2,000, and 5,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 120, 300, 850, 1,900, and 4,700 µg a.i./L. Mean length was significantly reduced by 6% at 4,700 µg a.i./L. The 32-day NOAEC was determined to be 1,900 µg a.i./L. The study was classified as acceptable.

Estuarine/Marine Fish

In a 96-hour acute toxicity study (MRID 51459426), Sheepshead Minnows (*Cyprinodon variegatus*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent controls), 1,500, 3,300, 7,200 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 710, 1,500, 3,500, 7,800, and 18,000 µg a.i./L. Based on low recoveries (51%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Mortality was 43% in the highest concentration. The 96-hour LC_{50} was determined to be >18,000 µg a.i./L. This study was classified as acceptable.

In a 34-day early life stage toxicity study (MRID 51459428), Sheepshead Minnows (*C. variegatus*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative and solvent controls), 310, 630, 1,300, 2,500, and 5,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 350, 530, 1,200, 1,900, and 4,900 µg a.i./L. At the LOAEC, 1,200 µg a.i./L (mean measured), length (↓4%), mean wet weight (↓13%), and mean dry weight (↓11%) were all significantly decreased. Embryo hatching success (↓10%), length (↓4%), mean wet weight (↓16%), and mean dry weight (↓16%) demonstrated obvious decreases at the lowest test level, 350 µg a.i./L; these decreases at the lowest test level were not statistically significant but may have biological relevance. The 34 day NOAEC was determined to be 530 µg a.i./L. The study was classified as supplemental, due to uncertainty related to the effects seen at the lowest test level. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).

3.3.1.2 Aquatic Invertebrate Studies

Water-Column Invertebrate

In a 48-hour acute toxicity study (MRID 51459432), daphnids (*Daphnia magna*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent controls), 1,500, 3,300, 7,200, 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 1,100, 2,300, 5,400, 12,000, and 27,000 µg a.i./L. Based on low recoveries (77%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. No significant effects to immobility were noted after 48 hours of exposure. At the highest concentration tested, lethargy was observed in 100% of organisms surviving until the end of the study. The 48-hour EC_{50} was determined to be >27,000 µg a.i./L. This study was classified as acceptable.

In a 48-hour acute toxicity study (MRID 51459433), daphnids (*D. magna*) were exposed to SYN510275 (metabolite of cyclobutrifluram) at nominal concentrations of 0 (negative control) and 99,000 µg a.i./L (102,000 µg a.i./L mean-measured). There were no effects to immobility in the control and treatment groups. The 48-hour EC_{50} was determined to be >102,000 µg a.i./L. This study was classified as acceptable.

In a 21-day full life cycle toxicity study (MRID 51459436), daphnids (*D. magna*) were exposed to cyclobutrifluram under static renewal conditions at nominal concentrations of 0 (negative control), 630, 1,300, 2,500, 5,000, and 10,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 660, 1,400, 2,600, 5,300, and 11,000 µg a.i./L. Significant effects to length (↓4%), number of offspring per surviving female (↓18%), successful birthrate (↓15%), and time to first brood (↑5%) were observed at 1,400 µg a.i./L. The 21-day NOAEC was determined to be 660 µg a.i./L. This study was classified as acceptable. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.

In a 96-hour acute toxicity study (MRID 51459434), Eastern Oysters (*Crassostrea virginica*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 31, 63, 130, 250, and 500 µg a.i./L. Mean-measured concentrations were determined to be <0.050 (<LOQ, control), 37, 67, 120, 240, and 490 µg a.i./L. Significant effects to shell deposition were observed; shell deposition was 2.3, 2.5, 2.1, 1.7, 1.6, and 0.65 mm for <0.050 (<LOQ, control), 37, 67, 120, 240, and 490 µg a.i./L exposure concentrations, respectively. The 96-hour IC_{50} was determined to be 290 µg a.i./L. The study was classified as supplemental, because the test substance was unstable at the two lowest test levels. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).

In a 96-hour acute toxicity study (MRID 51459469), mysids (*Americamysis bahia*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 560, 1,100, 2,300, 4,500, and 9,000 µg a.i./L. Mean-measured concentrations were determined to be <250 (<LOQ, control), 500, 1,000, 2,000, 4,100, and 8,000 µg a.i./L. Mortality was 0, 0, 0, 5, 10, 15% in the <250 (<LOQ, control), 500, 1,000, 2,000, 4,100, and 8,000 µg a.i./L treatment groups, respectively. The 96-hour EC_{50} was determined to be >8,000 µg a.i./L. This study was classified as acceptable.

In a 28-day flow through life cycle toxicity study (MRID 51459435), mysids (*A. bahia*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 78, 160, 310, 630, 1,300, and 2,500 µg a.i./L. Mean-measured concentrations were determined to be <25 (<LOQ, control), 79, 160, 310, 630, 1,300, and 2,400 µg a.i./L. Significant effects to time to first brood (↓17%) were observed at 310 µg a.i./L. The 28-day NOAEC was determined to be 160 µg a.i./L. The study was classified as supplemental, because the number of subjects per replicate were highly inconsistent or greater than guideline recommendations. It is suitable for quantitative use. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.

Benthic Invertebrate

In a 10-day subchronic toxicity study (MRID 51459444), the freshwater midge (*Chironomus dilutus*) was exposed to sediment applied cyclobutrifluram under intermittent renewal (of overlying water) conditions at nominal concentrations of 0 (solvent control), 5,000, 10,000, 20,000, 40,000, and 80,000 µg a.i./kg. Mean-measured concentrations were determined to be <50 (<LOQ, control), 4,500, 9,000, 20,000, 36,000, and 73,000 µg a.i./kg for sediment and <LOQ, 410, 940, 2,000, 4,100, and 10,000 µg a.i./L for pore water. Significant effects to survival were noted at 9,000 (↓21%), 36,000 (↓22%), and 73,000 (↓65%) µg a.i./kg. The 10-day NOAEC was determined to be 4,500 µg a.i./kg (410 µg a.i./L). This study was classified as acceptable. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.

In a 10-day subchronic toxicity study (MRID 51459445), estuarine amphipods (*Leptocheirus plumulosus*) were exposed to sediment applied cyclobutrifluram under intermittent renewal (of overlying water) conditions at nominal concentrations of 0 (solvent control), 6,300, 13,000, 25,000, 50,000, and 100,000 µg a.i./kg. Mean-measured concentrations were determined to be <50 (<LOQ, control), 4,100, 8,000, 16,000, 30,000, and 62,000 µg a.i./kg for sediment and <LOQ, 210, 460, 950, 2,200, and 4,500 µg a.i./L for pore water. Survival ranged from 85 to 92% in treatment groups compared to 86% in the control group. The 10-day NOAEC was determined to be 62,000 µg a.i./kg (4,500 µg a.i./L). This study was classified as acceptable.

Table 3-4. Aquatic Animal Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID or ECOTOX No./ Classification	Comments
Freshwater Fish (Surrogates for Vertebrates)					
Acute	TGAI (99.7)	Fathead Minnow (*Pimephales promelas*)	**96-h LC_{50} = 11,000**	**51459425 Acceptable**	Slightly Toxic
		Common Carp (*Cyprinus carpio*)	96-h LC_{50} > 19,000	51459427 Acceptable	29% mortality at highest concentration Endpoint may be approaching functional solubility.
		Rainbow Trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 13,000	51459423 Acceptable	Slightly Toxic 100% of surviving fish exhibited sublethal effects at highest concentration until complete mortality at 72h.
	SYN510275 (Metabolite) (99)	Fathead Minnow (*P. promelas*)	96-h LC_{50} > 99,000	51459424 Acceptable	
Chronic (ELS)	TGAI (99.7)	Fathead Minnow (*P. promelas*)	**32-d NOAEC = 1,900 LOAEC = 4,700**	**51459429 Acceptable**	Length ↓6% at LOAEC

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID or ECOTOX No./ Classification	Comments
Estuarine/Marine Fish (Surrogates for Vertebrates)					
Acute	TGAI (99.7)	Sheepshead Minnow (*Cyprinodon variegatus*)	**96-h LC_{50} > 18,000**	**51459426 Acceptable**	43% mortality at highest concentration and 100% partial loss of equilibrium in highest level at 48 and 72h Endpoint may be approaching functional solubility.
Chronic (ELS)	TGAI (99.7)	Sheepshead Minnow (*C. variegatus*)	**34-d NOAEC = 530 LOAEC = 1,200**	**51459428 Supplemental**	Effects at LOAEC Length ↓4% Dry Weight ↓11% Wet Weight ↓13% Larger, but not statistically significant, decreases in weight, as well as a 10% decrease in hatching success, were observed at the lowest test level, 350 µg a.i./L.
Freshwater Invertebrates (Water-Column Exposure)					
Acute	TGAI (99.7)	Water Flea (*Daphnia magna*)	**48-h EC_{50} > 27,000**	**51459432 Acceptable**	Lethargy in 100% at highest concentration tested. Endpoint may be approaching functional solubility.
	SYN510275 (Metabolite) (99)	Water Flea (*D. magna*)	48-h EC_{50} > 102,000	51459433 Acceptable	Practically Nontoxic
Chronic	TGAI (99.7)	Water Flea (*D. magna*)	**21-d NOAEC = 660 LOAEC = 1,400**	**51459436[1] Acceptable**	<u>Effects at LOAEC</u> Length ↓4% # Live Offspring↓18% Successful Birth Rate ↓15% Time to first brood ↑5%
Estuarine/Marine Invertebrates (Water-Column Exposure)					
Acute	TGAI (99.7)	Eastern Oyster (*Crassostrea virginica*)	**96-h IC_{50} = 290**	**51459434 Supplemental**	Highly Toxic Shell deposition
		Mysid (*Americamysis bahia*)	96-h LC_{50} > 8,000	51459469 Acceptable	

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID or ECOTOX No./ Classification	Comments
Chronic	TGAI (99.7)	Mysid (*A. bahia*)	**28-d** **NOAEC = 160** **LOAEC = 310**	**51459435[1]** **Supplemental**	Time to first brood ↓17% at LOAEC
Freshwater Invertebrate (Sediment Exposure)					
Subchronic	TGAI (99.7)	Freshwater Amphipod (*Hyalella azteca*)	10-d OC-Normalized Sediment: NOAEC = 3,500,000 µg a.i./kg -OC LOAEC > 3,500,000 µg a.i./kg-OC PW: NOAEC = 7,700 LOAEC > 7,700	51459443 Acceptable	
Subchronic	TGAI (99.7)	Midge (*Chironomus dilutus*)	**10-d** **OC-Normalized Sediment:** **NOAEC = 230,000 µg a.i./kg -OC** **LOAEC = 450,000 µg a.i./kg-OC** **PW:** **NOAEC = 410** **LOAEC = 940**	**51459444[1]** **Acceptable**	Survival ↓21% at LOAEC
Estuarine/ Marine Invertebrates (Sediment Exposure)					
Subchronic	TGAI (99.7)	Estuarine/ Marine Amphipod (*Leptocheirus plumulosus*)	**10-d** **OC-Normalized Sediment:** **NOAEC = 1,600,000 µg a.i./kg -OC;** **LOAEC > 1,600,000 µg a.i./kg-OC** **PW:** **NOAEC = 4,500;** **LOAEC > 4,500**	**51459445** **Acceptable**	

TGAI=Technical Grade Active Ingredient; TEP= Typical end-use product; a.i.=active ingredient

>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011b).

< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.

[1] This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.

3.3.2 Terrestrial Animal Toxicity

The available data indicate that cyclobutrifluram TGAI is practically non-toxic to three species of birds including passerines and practically non-toxic to mammals on an acute exposure basis, as no significant effects, up to the highest test levels, were observed in these acute studies. Studies submitted for bees also found cyclobutrifluram to be practically non-toxic to adult honey bees and larvae on an acute exposure basis.

No chronic exposure effects were identified for birds or mammals. In the 21-week reproductive toxicity study on the Northern Bobwhite Quail, the NOAEC and LOAEC were 1899 and >1899 mg a.i./kg-diet; in the 22-week reproductive toxicity study on the Mallard Duck, the NOAEC and LOAEC were 1935 and >1935 mg a.i./kg-diet. In a 17-week 2-generation reproductive rat toxicity study, the NOAEC and LOAEC were 43.10 and >43.10 mg a.i./kg-bw/day.

In a 10-day chronic oral toxicity study, no effects of cyclobutrifluram exposure to adult honey bees were observed up to the highest concentration tested, 5.9 µg a.i./bee/day. For larval honey bees, chronic exposures to 0.428 µg a.i./larva/day led to a 33% increase in Day 15 mortality, and a 41% decrease in adult emergence.

3.3.2.1 Terrestrial Vertebrate Studies

Avian

In three separate 14-day acute oral toxicity studies (MRIDs 51459413, 51459414, 51459415), three species of birds, Northern Bobwhite (*Colinus virginianus*), Mallard Duck (*Anas platyrhynchos*), and Canary (*Serinus canaria*), were administered cyclobutrifluram (TGAI) at nominal concentrations of 0 (negative control) and 2000 mg a.i./kg bw. At 14 days in all studies, there were no effects to mortality in the control and treatment groups and no sublethal effects to body weight. The 14-day LD_{50} was determined to be >2000 mg a.i./kg bw for each study. These studies were classified as acceptable.

In an 8-day dietary toxicity study (MRID 51459421), Mallard Duck were administered diets containing cyclobutrifluram at nominal concentrations of 0 (solvent control), 562, 1000, 1780, 3160, and 5620 mg a.i./kg diet for 5 days followed by a 3 day recovery period. Mean-measured concentrations were determined to be <100 (<LOQ, solvent control), 572, 1052, 1768, 2960, and 5245 mg a.i./kg diet. At 8 days, there were no effects to mortality in the control and treatment groups. The 8-day dietary LC_{50} was determined to be >5245 mg a.i./kg diet. This study was classified as acceptable.

In a 21-week reproduction study (MRID 51459419), Northern Bobwhite Quail were administered diets containing cyclobutrifluram at nominal concentrations of 0 (control), 403, 805, and 2013 mg a.i./kg diet. Mean-measured concentrations were determined to be <100 (<LOQ, control), 390, 777, and 1899 mg a.i./kg diet. At 21 weeks, there were no treatment related effects to reproduction and mortality in the control and treatment groups and no signs

of overt toxicity. Incidental mortalities and injuries were noted throughout the study. The 21-week reproduction NOAEC/LOAEC was determined to be 1899/>1899 mg a.i./kg diet. This study was classified as acceptable.

Mammals

Two mammalian toxicity studies, acute oral (MRID 51460005) and 2-generation reproduction (MRID 51460033) conducted using the Laboratory Rat (*Rattus norvegicus*), were submitted to support registration of cyclobutrifluram. No effects to survival, growth, or reproduction from cyclobutrifluram exposure were observed in either study. The acute toxicity LC_{50} was determined to be >5,000 mg a.i./kg-bw. The chronic toxicity NOAEL/LOAEL was determined to be 43.10/>43.10 mg a.i./kg-bw/day.

3.3.2.2 Terrestrial Invertebrate Studies

Honey Bees

In a 48-hour acute oral and contact toxicity study (MRID 51459447), adult honey bees (*Apis mellifera*) were exposed to cyclobutrifluram at nominal doses of 0 (negative and solvent controls), 4.38, 8.75, 17.5, 35.0, and 70.0 µg a.i./bee, corresponding to nominal actual intake doses of 4.54, 8.97, 18.39, 36.44, and 72.23 µg a.i./bee for the oral test and 0 (negative and solvent controls), 12.5, 25.0, 50.0, 100, and 200 µg a.i./bee for the contact test. No mortalities were observed during the oral test, and mortality during the contact test reached 3%. The 48-hour LD_{50} was determined to be >72.23 µg a.i./bee for the oral test and >200 µg a.i./bee for the contact test. The study was classified as supplemental, and it is suitable for quantitative use.

In a 72-hour acute larval toxicity test (MRID 51459452), honey bee larvae were exposed to negative and solvent controls and cyclobutrifluram at nominal doses of 2.50, 5.00, 10.0, 20.0, and 30.0 µg a.i./larva, corresponding to measured dietary doses of 2.53, 5.25, 10.1, 19.4, and 30.9 µg a.i./larva. Mortality was not observed in the control groups and ranged from 4 to 15% in the treatment groups. At the end of the test, the number of bees with unconsumed diet ranged from 11 to 17 bees in the controls and 18 to 23 in the treatment groups. The 72-hour LD_{50} was determined to be >30.9 µg a.i./larva. The study was classified as supplemental, and it is suitable for quantitative use.

In a 10-day chronic feeding test (MRID 51459451), adult honey bees were exposed to negative and solvent controls and cyclobutrifluram at nominal actual intake doses of 0.44, 0.83, 1.48, 3.39, and 6.11 µg a.i./bee/day, corresponding to measured actual intake doses of 0.44, 0.84, 1.3, 3.1, and 5.9 µg a.i./bee/day. Mortality in the negative control was 5% and was 15% in the solvent control. Mortality ranged from 5 to 20% in the treatment groups and was not significantly different from controls. When compared to the negative control, the NOAEL for food consumption was non-definitive, as significant effects were observed in the solvent control (38% reduction) and all treatment groups. As this is most likely a result of the solvent and thickening agent used in the solvent control and test groups, food consumption was reanalyzed using the solvent control instead of the negative control; no significant effects to food consumption were identified for this reanalysis. The 10-day NOAEL was determined to be 5.9 µg a.i./bee/day. The study was classified as supplemental, and it is suitable for quantitative use.

In a 22-day chronic toxicity test (MRID 51459453), honey bee larvae were exposed, from day 3 to day 6 of the study, to negative and solvent controls and cyclobutrifluram at nominal daily dietary doses of 0.16, 0.393, 0.985, 2.47, and 6.15 µg a.i./larva/day, corresponding to measured daily dietary doses of 0.16, 0.428, 1.01, 2.4, and 5.9 µg a.i./larva/day. Significant effects to Day 15 mortality (↑41%) and Day 22 Adult Emergence (↓41%) were observed at 0.428 µg a.i./larva/day. Unconsumed diet was noted in all groups (6 to 13 larvae per group) except the negative control. The 22-day NOAEL was determined to be 0.16 µg a.i./larva/day. The study was classified as supplemental, and it is suitable for quantitative use. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.

One study assessing cucumber pollen and nectar residues (MRID 51459450) following soil applications of cyclobutrifluram at 0.178 lb a.i./A was submitted. The study was conducted across three field locations with three varieties of cucumber. The largest residue detections were from pollen samples across all sites, with the maximum mean of 0.113 mg/kg (0.044 - 0.241 mg/kg) being detected 33 days after the last application in Trial 003. All nectar residues were below the limit of quantitation except one sample in Trial 003 at 33 days after the last application, which had a mean maximum of 0.0123 mg/kg. Other matrices were sampled during this study, but due to low recoveries in pollen and nectar, they were not analyzed. The study was classified as supplemental, and Trial 001 and Trial 003 were suitable for quantitative use; Trial 002 was only apt for qualitative use, due to several limitations and inconsistencies in comparison to the other trials.

Table 3-5. Terrestrial Animal Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value*	MRID or ECOTOX No./ Classification	Comments
Birds (Surrogates for Terrestrial Amphibians and Reptiles)					
Acute Oral	TGAI (99.7)	Bobwhite Quail (*Colinus virginianus*)	**14-d LD_{50} > 2000 mg a.i./kg-bw**	**51459413 Acceptable**	Practically Nontoxic
		Mallard (*Anas platyrhynchos*)	14-d LD_{50} > 2000 mg a.i./kg-bw	51459414 Acceptable	Practically Nontoxic Regurgitation observed
		Canary (*Serinus canaria*)	14-d LD_{50} > 2000 mg a.i./kg-bw	51459415 Acceptable	Practically Nontoxic

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value*	MRID or ECOTOX No./ Classification	Comments
Sub-acute dietary	TGAI (99.7)	Bobwhite Quail (*C. virginianus*)	8-d LC_{50} > 5259 mg a.i./kg diet	51459422 Acceptable	Practically Nontoxic
		Mallard (*A. platyrhynchos*)	**8-d LC_{50} > 5245 mg a.i./kg diet**	**51459421 Acceptable**	Practically Nontoxic
Chronic	TGAI (99.7)	Bobwhite Quail (*C. virginianus*)	**21-week NOAEC = 1899 LOAEC > 1899 mg a.i./kg-diet**	**51459419 Acceptable**	No treatment related effects
		Mallard (*A. platyrhynchos*)	22-week NOAEC = 1935 LOAEC > 1935 mg a.i./kg-diet	51459420 Acceptable	No treatment related effects
Mammals					
Acute Oral	TGAI (80.3)	Laboratory Rat (*Rattus norvegicus*)	**14-d LD_{50} = >5000 mg a.i./kg-bw**	**51460005 Acceptable**	Practically Nontoxic
Chronic (2-generation reproduction)	TGAI (80.3)	Laboratory Rat (*R. norvegicus*)	**17-week NOAEL = 43.1 LOAEL > 43.1 mg a.i./kg-bw/day**	**51460033 Acceptable**	No treatment related effects to apical endpoints
Terrestrial Invertebrates					
Acute contact & oral (adult)	TGAI (99.7)	Honey bee (*Apis mellifera*)	**Contact: 48-hr LD_{50} > 200 µg a.i./bee Oral: 48-hr LD_{50} > 72.23 µg a.i./bee**	**51459447 Supplemental**	Practically Nontoxic
Chronic oral (adult)	TGAI (99.7)	Honey bee (*Apis mellifera L.*)	**10-day NOAEL = 5.9 LOAEL = >5.9 µg a.i./bee/day**	**51459451 Supplemental**	No treatment related effects
Acute oral (larval)	TGAI (99.7)	Honey bee (*Apis mellifera carnica*)	**72-hr LD_{50} > 30.9 µg a.i./bee**	**51459452 Supplemental**	Practically Nontoxic
Chronic oral (larval)	TGAI (99.7)	Honey bee (*Apis mellifera L.*)	**22-day NOAEL = 0.16 LOAEL = 0.428 µg a.i./larva/day**	**51459453[1] Supplemental**	<u>Effects at LOAEL</u> Day 15 Mortality ↑41% Adult Emergence ↓41%
Residues in Pollen and Nectar	TEP (38.1%)	Cucumber (*Cucumis sativus*)	DT_{50} not calculable (Mean maximum: Pollen = 0.241 mg/kg; Nectar = 0.0123 mg/kg)	51459450 Supplemental	Not suitable for comparison to proposed uses, due to treatment stage (17-18 days after planting) and tested crop.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value*	MRID or ECOTOX No./ Classification	Comments
Semi-field study or full field study	No Data				

TGAI=Technical Grade Active Ingredient; TEP= Typical end-use product; a.i.=active ingredient
*NOAEC/NOAEL and LOAEC/LOAEL are reported in the same units.
>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011b).
< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.
[1] This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.

3.3.3 Plant Toxicity

3.3.3.1 Aquatic plants

Significant decreases in yield, growth rate, and/or area under the curve (AUC) were noted for all aquatic plant species tested, except cyanobacteria (**Table 3-6**). For aquatic plants, the highest impacts to growth from exposure to cyclobutrifluram were observed in the toxicity study for Green Algae (*Raphidocelis subcapitata)*. One aquatic plant (Green Algae) study using the metabolite SYN510275 was submitted, and no significant impacts were observed.

For vascular plants, duckweed (*Lemna gibba*), a 9% decrease in frond yield at 1,400 µg a.i./L was observed after a 7-day exposure period to cyclobutrifluram.

For non-vascular plants, the most sensitive species was Green Algae where significant decreases in the AUC (↓77%), cell density (↓78%), and growth rate (↓28%) were observed with exposure at 8,900 µg a.i./L. While the study for *Navicula pelliculosa* resulted in the most sensitive NOAEC for non-vascular plants, this study was deemed to only be appropriate for qualitative use; both the NOAEC and IC_{50} were non-definitive, and the study resulted in an inverse dose response.

Aquatic Plant Studies

Vascular

In a 7-day toxicity test (MRID 51459446), duckweed was exposed to cyclobutrifluram, under static renewal conditions, at nominal concentrations of 0 (negative control), 270, 640, 1,600, 4,000, 10,000, and 25,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, negative control), 250, 570, 1,400, 3,600, 9,700, and 16,000 µg a.i./L. Frond yield, final biomass, and growth rate (frond number and biomass) were all significantly affected in at least one treatment group. In comparison to control, percent inhibition to frond number, the

most sensitive endpoint, ranged from -3 to 60% for the treatment groups. The 7-day IC_{50} and NOAEC were determined to be 11,000 µg a.i./L and 570 µg a.i./L, respectively. This study was classified as acceptable.

Non-vascular

In a 96-hour toxicity study (MRID 51459438), freshwater algae (*R. subcapitata*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative and solvent control), 900, 2,200, 5,600, 14,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 620, 1,400, 3,600, 8,900, and 22,000 µg a.i./L. Yield, growth rate, and AUC were significantly inhibited in the two highest treatment groups. In comparison to negative control, % inhibition to AUC, the most sensitive endpoint, ranged from -5 to 98% for the treatment groups. The 96-hour IC_{50} and NOAEC were determined to be 7,000 µg a.i./L and 3,600 µg a.i./L, respectively. This study was classified as acceptable.

In a 96-hour toxicity study (MRID 51459439), freshwater algae (*R. subcapitata*) were exposed to SYN510275, a metabolite of cyclobutrifluram, at nominal concentrations of 0 (negative control), 9,400, 17,000, 31,000, 55,000, and 99,000 µg a.i./L. Initial-measured concentrations were determined to be <1.8 (<LOQ, control), 9,200, 17,000, 31,000, 57,000, and 103,000 µg a.i./L. No significant effects were observed throughout the study. The 96-hour IC_{50} and NOAEC were determined to be >103,000 µg a.i./L and 103,000 µg a.i./L, respectively. This study was classified as acceptable.

Table 3-6. Aquatic Plant Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value (µg a.i./L)	MRID or ECOTOX No./ Classification	Comments
Aquatic Plants and Algae					
Vascular	TGAI (99.7)	Duckweed (*Lemna gibba*)	**7-day IC_{50} = 11,000** **7-day NOAEC = 570**	**51459446 Acceptable**	Frond Yield at LOAEC ↓9%
Non-vascular	TGAI (99.7)	Green Algae (*Raphidocelis subcapitata*)	**96-hour IC_{50} = 7,000** **96-hr NOAEC = 3,600**	**51459438 Acceptable**	Effects at LOAEC: AUC ↓77% Cell Density ↓78%, Growth Rate ↓28%
		Marine Diatom (*Skeletonema costatum*)	96-hour IC_{50} > 13,000 96-hr NOAEC = 4,900	51459441 Acceptable	AUC at LOAEC ↓11% IC_{50} may be approaching functional solubility.
		Cyanobacteria (*Anabaena flos-aquae*)	96-hour IC_{50} > 24,000 96-hr NOAEC = 24,000	51459440 Acceptable	IC_{50} may be approaching functional solubility.
		Freshwater Diatom (*Navicula pelliculosa*)	96-hour IC_{50} > 17,000 96-hr NOAEC < 1,300	51459442[1] Supplemental*	Effects at LOAEC: Yield ↓28% Growth Rate ↓8% AUC ↓23% IC_{50} may be approaching functional solubility.
	SYN510275 (Metabolite) (99)	Green Algae (*R. subcapitata*)	96-hour IC_{50} > 103,000 96-hr NOAEC = 103,000	51459439 Acceptable	

TGAI=Technical Grade Active Ingredient; a.i.=active ingredient
>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011b).
< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.
*For qualitative use only.
[1] This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.

3.3.3.2 Terrestrial Plants

The available data for terrestrial plants exposed to the formulated product SYN549522 SC (A22011B) (38.7% a.i.), indicate that cyclobutrifluram exposure to seeds in treated soils resulted in reduced emergence (26%) and survival (26%) for the monocot ryegrass at the highest tested concentration (0.80 lb a.i./A). No significant effects to dicots were noted in the seedling emergence study. No significant effects to any species were noted in the vegetative vigor study.

Terrestrial Plant Studies

In a terrestrial plant seedling emergence and seedling growth test (MRID 51459460), monocot and dicot crops were exposed to SYN549522 SC (A22011B; a.i. cyclobutrifluram, 38.7% (w/w)) at nominal concentrations ranging from 0.010 to 0.81 lb a.i./A and observed over 21 days. Concentrations were analytically confirmed in the highest test level for each crop; the highest test level measured concentration was determined to be 0.80 lb a.i./A for corn, oat, onion, ryegrass, and sugar beet and 0.81 lb a.i./A for cucumber, lettuce, oilseed rape, soybean, and tomato. Significant inhibitions to seedling emergence and survival at 0.80 lb a.i./A were noted for ryegrass only. There were no significant effects to seedling height or dry weight for any crops in the study. The 21-day NOAEC/EC_{25} for ryegrass, the most sensitive monocot crop, were determined to be 0.27 lb a.i./A and >0.80 lb a.i./A, respectively. With the exception of sugar beet, which had a NOAEC of 0.80 lb a.i./A, the NOAEC for dicot crops was determined to be 0.81 lb a.i./A. This study was classified as acceptable.

In a terrestrial plant vegetative vigor test (MRID 51459461), monocot and dicot crops were exposed, at BBCH 12 or 13, to SYN549522 SC (A22011B; a.i. cyclobutrifluram, 38.7% (w/w)) at nominal concentrations ranging from 0.010 to 0.81 lb a.i./A and observed for 21 days. Concentrations were analytically confirmed in the highest test level for each crop, and the measured concentration was determined to be 0.80 lb a.i./A for all crops tested. No significant inhibitions to survival, seedling height, or dry weight were noted for any crops in the study. The 21-day NOAEC for all species was determined to be 0.80 lb a.i./A. This study was classified as acceptable.

Table 3-7. Terrestrial Plant Toxicity Endpoints for Cyclobutrifluram

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value (lb a.i./A)	MRID or ECOTOX No./ Classification	Comments
Terrestrial and Wetland Plants					
Seedling Emergence	TEP (38.7)	4 monocots 6 dicots	Dicots (All): IC_{25} >0.80*/>0.81 NOAEC = 0.80*/0.81 **Monocots (Ryegrass):** **IC_{25} >0.80** **NOAEC = 0.27**	**51459460** **Acceptable**	Dicots: No effects at the highest concentration tested. Monocots: Emergence (↓26%) Survival (↓26%)

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value (lb a.i./A)	MRID or ECOTOX No./ Classification	Comments
Vegetative Vigor	TEP (38.7)	4 monocots 6 dicots	Dicots (All): IC_{25} >0.80 NOAEC = 0.80 Monocots (All): IC_{25} >0.80 NOAEC = 0.80	51459461 Acceptable	Dicots & Monocots: No effects at the highest concentration tested.

TEP= Typical end-use product; a.i.=active ingredient
*The highest test level for sugar beet was 0.80 lb a.i./A, while the rest of the dicot group had the highest test level at 0.81 lb a.i./A.
>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011b).
< Less than values designate non-definitive endpoints where growth, reproductive, and/or mortality effects are observed at the lowest tested concentration.

3.3.4 ECOSAR Analysis

In support of cyclobutrifluram (SYN549522) registration, three metabolite studies were submitted for aquatic taxa for the metabolite SYN510275. These studies were conducted using freshwater fish, invertebrates, and green algae. No effects were noted in any of the SYN510275 studies up to their respective highest tested concentrations (**Table 3-4** and **Table 3-6**). As data were only submitted for one of several identified degradates of cyclobutrifluram, the Ecological Structure Activity Relationships Program (ECOSAR[19]; version 2.2) has been utilized to predict the potential toxicity of cyclobutrifluram metabolites to various aquatic taxa.

Cyclobutrifluram, as discussed in **Section 3.2** has six degradates that only sporadically formed at >10% of applied in environmental fate studies: SYN510275, SYN510260, CGA177291, EXC8199, SYN551231, and Trifluoroacetic acid (TFA). In general, there was limited transformation of parent over the duration of these studies reducing the likelihood of formation of these degradates in large quantities. The transformation pathways appeared to be consistent across test systems (following the pathways in soil and aquatic/ sediment systems shown in **Figure 1**), when considering that the degradates that are trackable with the phenyl-U-^{14}C]- and [pyridinyl-2-^{14}C labels are different after the molecule splits between these two ring structures**.**

Out of several test soils in the aerobic soil metabolism and related nonguideline studies SYN510275 was only confirmed to be present at up to 7 to 19% in three test soil systems in a soil column study. Combined SYN510275 and SYN510260 (Not separately analyzed samples) was detected at 8 to 24% in the same three test soil systems. In the two anaerobic aquatic and the two anaerobic soil metabolism studies there were no transformation products formed at >10% of applied. Degradates only detected in photolysis studies were SYN551231 and

[19] https://www.epa.gov/tsca-screening-tools/ecological-structure-activity-relationships-ecosar-predictive-model

SYN551241 found at up to 39% and 5%, respectively. Other degradates found in photolysis studies and one or more fate studies include (1.) EXC8199 found at 12% in a soil photolysis test (Also found at barely detectable levels - 0.08% of applied in only one of eight field dissipation tests) and (2) SYN510275 found at 37% in the aqueous photolysis, 2 – 14% in several field dissipation studies and in soil column studies as noted above. Further details of their formation in each environmental fate test are provided in Appendix B, **Table B-1**.

There are two notable minor degradates: SYN551241 and SYN549104. ECOSAR was used to predict the toxicity of these degradates in comparison to the parent chemical, based on predicted toxicity to aquatic taxa. ECOSAR predicted endpoints for the parent and degradates were used to determine the residues of toxicological concern for cyclobutrifluram use, based on the process outline in the 2018 ECOSAR guidance (USEPA, 2018). This analysis was used in addition to results from registrant-submitted data for the parent and the primary degradate SYN510275 (**Table 3-4; Table 3-6**). Based on registrant-submitted data, the parent compound is approximately 4X - 14X more acutely toxic than the primary degradate (SYN510275) for freshwater fish, freshwater invertebrates, and algae.

To determine the reliability of the ECOSAR analysis in predicting toxicity values for cyclobutrifluram, ECOSAR estimates (**Table 3-8**) were compared to registrant-submitted empirical aquatic toxicity data for cyclobutrifluram. The ECOSAR classes Neutral Organics and Amides are the best class matches in comparison to the registrant-submitted data. When available, the Amides class was used for comparisons. If predictions for the Amides class were not provided by ECOSAR for an individual degradate, the Neutral Organics class was used for comparisons. When considering both Neutral Organics and Amides, all definitive endpoint comparisons for the parent compound were rated as good, as they are within 5X of the empirical values in the registrant-submitted data. For non-definitive toxicity endpoints, the ECOSAR estimates were determined to be consistent with the registrant-submitted data, as they were within the same order of magnitude with the exception of the comparisons for chronic estuarine/marine fish (only predictions for Neutral Organics are provided by ECOSAR for this endpoint).

As previously stated, SYN510275 is less toxic than the parent compound, based on the registrant-submitted data. The ECOSAR analysis also supports this conclusion, as toxicity estimates are greater than 70X the ECOSAR estimates for the parent based on the Neutral Organics class and greater than 40X for the Amides class. For SYN551231, estimates for the Amides class range from 6.54X (acute E/M invertebrates) - 34.71X (chronic E/M invertebrates) of the ECOSAR estimates for the parent, and based on maximum percent formation (39.5%) and relative toxicity, it is not considered to be a degradate of concern. For CGA177291, Neutral Organics class toxicity estimates range from 8.50X (chronic E/M fish) – 15.51X (chronic E/M invertebrates) of the parent ECOSAR estimates, and based on maximum percent formation (15.8%) and relative toxicity, it is not considered to be a degradate of concern. For SYN510260, estimates for the Neutral Organics class range from 76.63X (chronic E/M fish) - 1536.19X (chronic E/M invertebrates) of the ECOSAR estimates for the parent, and it is not considered to be a degradate of concern, as it is at least one order of magnitude less toxic than the parent.

For EXC8199, estimates for the Neutral Organics class range from 10.61X (chronic E/M fish) - 22.75X (chronic E/M invertebrates) of the ECOSAR estimates for the parent, and it is not considered to be a degradate of concern, as it is at least one order of magnitude less toxic than the parent. For TFA, estimates for the Neutral Organics class range from 146.84X (chronic E/M fish) - 10546.60X (chronic E/M invertebrates) of the ECOSAR estimates for the parent, and it is not considered to be a degradate of concern, as it is at least two orders of magnitude less toxic than the parent. For SYN549104 (A primary Degradate which only differs from parent by a hydroxyl substitution on the cyclobutyl ring), estimates for the Amides class range from 0.35X (chronic E/M invertebrates) - 0.55X (acute E/M invertebrates) of the ECOSAR estimates for the parent, and based on maximum percent formation (9.9%) and relative toxicity, it meets the ECOSAR criteria for potentially being considered a degradate of concern. For SYN551241, estimates for the Neutral Organics class range from 0.02X (chronic E/M invertebrates) - 0.11X (chronic E/M fish) of the ECOSAR estimates for the parent, and based on maximum percent formation (5.0%) and relative toxicity, it meets the ECOSAR criteria for potentially being considered a degradate of concern.

The ECOSAR analysis, along with submitted registrant data for the parent and the primary degradate, SYN510275, supports the determination that the major (*i.e.,* >10% formation) degradates are less toxic than the parent compound (*i.e*., generally, one or more orders of magnitude less toxic or moderately less toxic and due to percent formation rate the degradate is not of concern). While ECOSAR flagged the two minor degradates (<10% formation) as potential concerns based on relative toxicity to the parent and percent formation, the long half-life of the parent (estimated to be 925 days) suggests including these degradates would not substantially change the risk conclusions. In addition, studies for these minor degradates have not been submitted for review. Therefore, the stressor of concern for cyclobutrifluram use is determined to consist of the parent compound only.

Table 3-8. Registrant-submitted data compared to ECOSAR predicted toxicity of cyclobutrifluram and its primary degradates.

Compound (ECOSAR class)	Toxicity Endpoint (ug a.i./L)								
	Acute FW Fish LC_{50}	Acute FW Invert LC_{50}	Chronic FW Fish NOAEC	Chronic FW Invert NOAEC	Acute E/M Fish LC_{50}	Acute E/M Invert LC_{50}	Chronic E/M Fish NOAEC	Chronic E/M Invert NOAEC	Algae EC_{50}
Cyclobutrifluram									
Registrant Submitted Data									
Cyclobutrifluram - TGAI	11,000	>27,000	1,900	660	>18,000	>8,000	<350	160	7,000
ECOSAR Estimates									
Neutral Organics	26,700	17,000	2,980	2,250	33,900[1]	11,200	7,660	677	20,000
Amides	12,600	10,200	278	2,630	14,400	1,330		51	2,370
SYN510275									
Registrant Submitted Data									
SYN510275	>99,000	>102,000							>103,000
ECOSAR Estimates									
Neutral Organics	15,500,000[1]	7,160,000[1]	1,190,000	394,000	19,200,000[1]	64,400,000[1]	537,000	10,800,000[1]	2,280,000
Amides	2,880,000	3,920,000[1]	14,200	287,000	1,910,000	59,800		48,800	156,000
SYN551231									
ECOSAR Estimates									
Neutral Organics	705000	376000	64100	30900	884000	1030000	63900	109000	217000
Amides	200000	215000	1950	27900	170000	8700		1770	19100
CGA177291									
ECOSAR Estimates									
Neutral Organics	287000	176000	30700	21200	364000	155000	65100	10500	179000
SYN510260									
ECOSAR Estimates									
Neutral Organics	6590000[1]	3510000	597000	286000	8260000[1]	9820000[1]	587000	1040000	2010000
EXC8199									
ECOSAR Estimates									
Neutral Organics	382000	232000	40400	27200	483000	221000	81300	15400	227000

Compound (ECOSAR class)	Toxicity Endpoint (ug a.i./L)								
	Acute FW Fish LC_{50}	Acute FW Invert LC_{50}	Chronic FW Fish NOAEC	Chronic FW Invert NOAEC	Acute E/M Fish LC_{50}	Acute E/M Invert LC_{50}	Chronic E/M Fish NOAEC	Chronic E/M Invert NOAEC	Algae EC_{50}
TFA									
ECOSAR Estimates									
Neutral Organics	20725350	10248302	1720957	680191	25858791	52999613	1124789	7140045	4309893
SYN549104									
ECOSAR Estimates									
Neutral Organics	10200[1]	6750[1]	1190	1020	12900[1]	3070[1]	3930[1]	161	9570[1]
Benzyl Alcohols	4010[1]	3670[1]	510	927[2]					3040[1]
Amides	5460[1]	4120[1]	150	1270	6760[1]	728		18	1230
SYN551241									
ECOSAR Estimates									
Neutral Organics	1550	1080	193	184	1980	335	816	15	1850

ECOSAR = Ecological Structure Activity Relationships (ECOSAR) Predictive Model
SYN510275 represents 2-(Trifluoromethyl) nicotinamide
SYN551231 represents 2-(Trifluoromethyl)-N-vinylnicotinamide
CGA177291 represents 2,4-Dichlorobenzoic acid
SYN510260 represents 2-(Trifluoromethyl) nicotinic acid
EXC8199 represents 2-(2,4-Dichlorophenyl) acetic acid
TFA represents 2,2,2-Trifluoroacetic acid
SYN549104 represents N-((1S,2R)-2-(2,4-dichlorophenyl)-2-hydroxycyclobutyl)-2-(trifluoromethyl)nicotinamide
SYN551241 represents 2,4-Dichloro-1-vinylbenzene
[1]ECOSAR Note: Chemical may not be soluble enough to measure this predicted effect.
[2]ECOSAR Note: Estimated using an acute-to-chronic ratio (ACR).

3.4 Aquatic Animal Risk Assessment

3.4.1 Aquatic Exposure Assessment

3.4.1.1 Modeling

This section estimates the surface water body exposure from the proposed uses as specified in **Table 2-1**.

Standard Farm Pond

Surface water aquatic modeling is simulated using the Pesticide in Water Calculator (PWC version 2.001) for use patterns to terrestrial areas. Pesticide in Water Calculator Scenarios are used to specify soil, climatic, and agronomic inputs in the Pesticide Root Zone Model (PRZM) and are intended to result in high-end water concentrations associated with a particular crop and pesticide within a geographic region. Each PWC scenario is specific to a vulnerable area where the crop is commonly grown. For the agricultural uses (Romaine lettuce, cotton seed, and soybean seed) a representative scenario is selected for each Hydrologic Unit Code 2-digit (HUC-2)[20] region in the United States where that crop may be grown. Soil and agronomic data specific to the location are built into the scenario, and a specific climatic weather station (or interpolation between weather stations) providing approximately 54 years daily weather values is associated with the location.

Model input parameters were selected in accordance with EFED's guidance documents (USEPA, 2009; USEPA, 2010; USEPA, 2013; USEPA 2012a, 2013b; USEPA, 2014a; USEPA, 2015; USEPA and Health Canada, 2012). Chemical input parameters used in modeling are presented in **Table 3-9** and were calculated for cyclobutrifluram parent**.** The dates of application for each simulated use pattern are determined by the label directions and set in conjunction with the scenario emergence or other crop cycle dates built into the model scenarios. **Table 3-10** identifies the use sites, scenario representations, and application parameters associated with each PRZM scenario.

Table 3-9. Chemical Related Aquatic Modeling Input Parameters for Cyclobutrifluram

Parameter (units)	Value (s)	Source	Comments
K_{foc} (mL/g)	376	MRID 51460215	Average of 6 values for parent. The coefficients of variation for K_F and K_{FOC} are substantially similar and the K_{OC} is known to be a good predictor of sorption for neutral organic compounds
Water Column Metabolism Half-life (days) at 20°C	841	MRID 51460220	Represents the 90 percent upper confidence bound on the mean of 2 half-life values from aerobic aquatic metabolism studies.

[20] https://nas.er.usgs.gov/hucs.aspx

Parameter (units)	Value (s)	Source	Comments
Benthic Metabolism Half-life (days) at 20°C	1806	MRID 51460219	Represents the 90 percent upper confidence bound on the mean of 2 half-life values from anaerobic aquatic metabolism studies
Aqueous Photolysis Half-life (days)@ 20°C, pH 7	23.4 at 40°N	MRID 51460223	Corrected for 12-hr day/night and solar radiation at 40°N.
Hydrolysis Half-life (days)	Stable (PWC entry 1E8)	MRID 51460222	
Soil Half-life (days) at 20°C	925	MRIDs 51460201 51460202	Represents the 90 percent upper confidence bound on the mean of half-life values from aerobic soil metabolism studies in 5 different soils.
Foliar Half-life (days)	--	--	No Data
Molecular Weight (g/mol)	389.2	MRID 51459902	
Vapor Pressure (Torr) at 20°C	4.65×10^{-8}	MRID 51459902	
Solubility in Water (mg/L)	33	MRID 51459902	
Henry's Coefficient (unitless)	3.12×10^{-8}	--	Calculated from molecular weight, vapor pressure (torr), and solubility (mg/L)
Heat of Henry (J/mol)	--	--	Compound is not volatile, not calculated

[1] Other input parameters for the applications tab are shown in **Table 3-10**.

[2] *Methods for Assessing Aquatic Exposure to Residue(s) of Concern*, U.S. Environmental Protection Agency, June 20, 2019

Table 3-10. PWC Input Parameters Specific to Use Patterns for Cyclobutrifluram (Applications Tab and Crop/land Tab)

Use Site	PWC Scenario(s)[1]	Date of Initial App.[2]	App. Rate in kg a.i./ha (lb a.i./A)[3]	# App. per Year	App. Interval (days)	App Method	Application Efficiency/Spray Drift Fraction
Cotton (seed)	9 regional	Emg-8d	0.095 (0.085)	1	NA	Seed[5]	0.99/ 0.00
Lettuce (romaine only)	21 regional	Emg+14d	0.100 (0.089)	1	14	Ground (soil)	0.99/ 0.062
Soybean (seed)	18 regional	Emg-7d	0.095 (0.085)	1	NA	Seed[5]	0.99/ 0.00
Turf	FL turf std. PA turf std.[4]	Emg+44d @180w, 30s (FL) Emg+14d @150w, 25s (PA)	0.252 (0.225)	2	14	Foliar	

Use Site	PWC Scenario(s)[1]	Date of Initial App.[2]	App. Rate in kg a.i./ha (lb a.i./A)[3]	# App. per Year	App. Interval (days)	App Method	Application Efficiency/Spray Drift Fraction
Ornamentals / Nursery	CA, FL, MI, NJ, OR, and TN Nursery std.[4]	Apr1 @210w, 30s	0.210 (0.187)	2	14	Ground (soil)	0.99/ 0.062

[1] PWC= Pesticide Water Calculator; Regional scenarios developed in 2022 were run for agricultural sites. Std. = Legacy PWC scenarios still in use for most non-agricultural sites.
[2] App= Application; Emg= Emergence; d= day; s= time step in days and w= total time window in days, both of PWC date batch runs.
[3] a.i.= Active ingredient
[4] The turf and ornamental scenarios were adapted with new weather files adopted by EFED.
[5] Used Chemical Application Method (CAM) 5 = soil applied, user-defined incorporation depth (DEPI), linearly increasing with depth (USEPA , 2020). The target depth of planting chosen was 0.95 cm for soybean seed and 1.95 cm for cotton seed. CAM 5 is intended to allow the flexibility to simulate an application intended to be placed at a predetermined depth such as done for seed planting.

The application timing and scenario resulting in the highest EEC for each use scenario is shown in **Table 3-11**.The highest expected exposure is from the ornamentals (outdoor uses) followed by turf grass, and then by romaine lettuce. Lower exposures are estimated for cotton and soybeans which are seed treatments only.

Table 3-11. Surface Water EECs for Cyclobutrifluram (Estimated Using PWC version 2.001)

Use Site	Scenario for Max. EEC2	Surface Water EECs (µg/L)			Pore water EECs (µg/L)		Sediment (µg/kg dry sdmt.)	
		1-Day	21-Day	60-Day	Peak	21- Day	Peak	21-Day
Ornamentals, Soil[1]	MI Nursery	14.69	14.43	14.19	13.73	13.73	211.6	211.6
Turf grass, foliar	PA Turf	12.66	12.36	11.98	11.08	11.06	170.74	170.43
Lettuce, soil	Veget. Market Region 8-B	5.14	4.97	4.71	4.22	4.17	64.95	64.20
Cotton, seed	Cotton Region 8-B	4.15	4.01	3.83	3.38	3.38	52.09	52.05
Soybean, seed	Soybean, Region 8-B	2.41	2.32	2.20	1.92	1.90	29.59	29.23

[1] The highest exposures for ornamentals as presented here are for outdoor soil planted ornamental plants.
2 Veget.= Vegetable. Where applicable, the region listed is the HUC-2 region with the highest predicted EECs.

3.4.1.2 Monitoring

Cyclobutrifluram is a new chemical proposed for registration in the United States. Therefore, surface water and groundwater monitoring have not been conducted for this chemical or for the transformation products of this chemical.

3.4.2 Aquatic Animal Risk Characterization

3.4.2.1 Aquatic Vertebrates

Acute and chronic risks to aquatic vertebrates, freshwater (FW) and estuarine/marine (E/M) fish, were assessed based on EECs from multiple use patterns and application rates (**Table 3-12**). Previously modeled daily and 60-day mean EECs were used for comparison to the endpoints determined from the submitted studies. The available data suggests acute and chronic risk to fish and aquatic-phase amphibians from the use of cyclobutrifluram is expected to be low.

Acute risk of concern from cyclobutrifluram exposure was not identified for FW fish; based on daily EECs and an LC_{50} of 11,000 µg a.i./L, RQ values were all <0.01. Due to a non-definitive LC_{50}, acute RQ values could not be calculated for aquatic E/M vertebrates. Based on comparison of the daily mean EECs (2.4 – 15 µg a.i./L) and the E/M fish LC_{50} (>18,000 µg a.i./L), EECs are at least three orders of magnitude lower than the highest tested concentration. This comparison indicates that acute risk concerns are not indicated for E/M fish since an assumed LC_{50} at the highest test concentration would result in an acute RQ less than the acute risk LOC of 0.5 for non-listed species.

For FW fish, chronic risk of concern is low since chronic RQ values are below the chronic risk LOC of 1.0 and range from <0.01 to 0.01. Furthermore, the maximum 60-day mean EEC (14 µg a.i./L) is about 336X lower than the chronic LOAEC of 4,700 µg a.i./L for FW fish based on 6% reductions in length. For E/M fish, chronic risk of concern is also low. Chronic RQ values for E/M fish are below the chronic risk LOC of 1.0 and range from <0.01 to 0.03. The maximum 60-day mean EEC is 86X lower than the LOAEC of 1,200 µg a.i./L for E/M fish, which is based on a 13% reduction in wet weight.

Table 3-12. Acute and Chronic Aquatic Vertebrate Risk Quotients

Use Sites	1-in-10 Yr EEC (µg/L)		Risk Quotient (RQ)			
			Freshwater (FW)		Estuarine/Marine (E/M)	
	Daily Mean	60-day Mean	Acute[1,3]	Chronic[2,4]	Acute[1,3]	Chronic[2,4]
			LC_{50} = 11,000 µg a.i./L	NOAEC = 1,900 µg a.i./L	LC_{50} > 18,000 µg a.i./L	NOAEC = 530 µg a.i./L
Cotton, seed	4.2	3.8	<0.01	<0.01	NC	0.01
Soybean, seed	2.4	2.2	<0.01	<0.01	NC	<0.01
Lettuce, soil	5.1	4.7	<0.01	<0.01	NC	0.01
Turf grass, foliar	13	12	<0.01	0.01	NC	0.02
Ornamentals, soil	15	14	<0.01	0.01	NC	0.03

EEC=estimated environmental concentration; NC = not calculated due to non-definitive toxicity endpoint
The LOC for acute risk to non-listed species is 0.5 or the chronic risk LOC is 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.
[1] The EECs used to calculate these RQs are based on the 1-in-10-year peak 1-day average value from **Table 3-11.**
[2] The EECs used to calculate these RQs are based on the 1-in-10-year 60-day average value from **Table 3-11.**
[3] Measured LC_{50} from acute toxicity test with FW Fathead Minnow (*Pimephales promelas*; MRID 51459425) or E/M Sheepshead Minnow (*Cyprinodon variegatus*; MRID 51459426).
[4] Measured NOAEC from chronic toxicity test with Fathead Minnow (*P. promelas*; MRID 51459429) or E/M Sheepshead Minnow (*C. variegatus*; MRID 51459428).

3.4.2.2 Aquatic Invertebrates

Water-Column Exposures

Acute and chronic risks to freshwater and estuarine/marine (E/M) aquatic invertebrates (water-column) were assessed based on EECs from multiple use patterns and application rates (**Table 3-13**). Previously modeled daily and 21-day mean EECs were used for comparison to the endpoints determined from the submitted studies. The available data suggests acute and chronic risks to aquatic invertebrates in the water-column are expected to be low.

Acute risk from cyclobutrifluram exposure was not identified for non-listed aquatic invertebrates. Due to a non-definitive LC_{50}, acute RQ values could not be calculated for freshwater invertebrates. Based on comparison of the daily mean EECs (2.4 – 15 µg a.i./L) and the daphnid LC_{50} (>27,000 µg a.i./L), EECs are at least three orders of magnitude lower than the highest tested concentration. For E/M invertebrates, RQs ranged from 0.01 - 0.05, based on the endpoint for the shell deposition study; these RQ values did not exceed the LOC. When shell deposition is the most sensitive endpoint for aquatic estuarine/marine invertebrates, endpoints from additional species within the category are also assessed. An additional saltwater mysid acute toxicity study was submitted, and the endpoint was determined to be non-definitive. No effects were seen in the acute mysid study at the highest test concentration (>8000 µg a.i./L), which was at least two orders of magnitude higher than the estimated EECs.

Chronic risk is not indicated for aquatic invertebrates in the water-column; chronic RQ values range from <0.01 to 0.09. The maximum 21-day mean EEC (14 µg/L) is 100X lower than the chronic LOAEC of 1,400 µg a.i./L for freshwater invertebrates, based on several endpoints ranging from 4% to 18% effects to growth or reproduction. The maximum EEC is about 22X lower than the chronic LOAEC of 310 µg a.i./L for estuarine/marine invertebrates, based on 17% reductions in time to first brood.

Table 3-13. Acute and Chronic Aquatic Invertebrate (Exposed in the Water-Column) Risk Quotients

Use Sites	1-in-10 Yr EEC (µg/L)		Risk Quotient (RQ)				
			Freshwater (FW)		Estuarine/Marine (E/M)		
	Daily Mean	21-day Mean	Acute[1,3]	Chronic[2,4]	Acute[1,3]		Chronic[2,4]
			EC_{50} >27,000 µg a.i./L	NOAEC = 660 µg a.i./L	IC_{50} = 290 µg a.i./L*	LC_{50} >8000 µg a.i./L	NOAEC = 160 µg a.i./L
Cotton, seed	4.2	4.0	NC	0.01	0.01	NC	0.03
Soybean, seed	2.4	2.3	NC	<0.01	0.01	NC	0.01
Lettuce, soil	5.1	5.0	NC	0.01	0.02	NC	0.03
Turf grass, foliar	13	12	NC	0.02	0.04	NC	0.08
Ornamentals, soil	15	14	NC	0.02	0.05	NC	0.09

EEC=estimated environmental concentration; NC = not calculated due to non-definitive toxicity endpoint
The LOC for acute risk to non-listed species is 0.5 or the chronic risk LOC is 1.0. *Italicized* values exceed the LOC for acute risk to listed species of 0.05. The endpoints listed in the table are the endpoints used to calculate the RQ.
*Based on shell deposition study.
[1] The EECs used to calculate this RQ are based on the 1-in-10-year peak 1-day average value from **Table 3-11**.
[2] The EECs used to calculate this RQ are based on the 1-in-10-year 21-day average value from **Table 3-11.**
[3] Measured EC_{50}/IC_{50}/LC_{50} from Acute toxicity test with FW Water Flea (*Daphnia magna*; MRID 51459432) or E/M Eastern Oyster (*Crassostrea virginica*; MRID 51459434) or E/M Saltwater Mysid (*Americamysis bahia*; MRID 51459469).
[4] Measured NOAEC from Chronic toxicity test with FW Water Flea (*Daphnia magna*; MRID 51459436) or E/M Saltwater Mysid (*Americamysis bahia*; MRID 51459435).

Sediment Exposures

Acute and chronic risks to freshwater and estuarine/marine benthic invertebrates were assessed based on EECs from multiple use patterns and application rates (**Table 3-14**). Previously modeled daily and 60-day mean EECs were used for comparison to the endpoints determined from the submitted studies. The available data suggests acute and chronic risks to aquatic benthic invertebrates are expected to be low.

Due to a non-definitive LC_{50}, acute RQ values for freshwater benthic invertebrates could not be calculated. Based on comparison of the daily pore water (PW) mean EECs (1.9 – 14 µg a.i./L) and the daphnid EC_{50} (>27,000 µg a.i./L), EECs are at least three orders of magnitude lower than the highest tested concentration. For estuarine/marine invertebrates, RQs ranged from 0.01 - 0.05; these RQ values did not exceed the LOC.

Chronic risk is not indicated for benthic invertebrates; chronic RQ values range from <0.01 to 0.03. The maximum 21-day EECs for PW (14 µg/L) and bulk sediment (BS; 5289 µg/kg-OC) about

67X and 85X lower, respectively, than the chronic LOAECs of 940 µg a.i./L (PW) and 450,000 µg/kg-OC (BS) for freshwater benthic invertebrates, based on a 21% reduction in survival at the LOAEC. The maximum 21-day EECs for PW and BS at least two orders of magnitude lower than the chronic LOAECs of >4,500 µg a.i./L (PW) and >1,600,000 µg/kg-OC (BS) for estuarine/marine benthic invertebrates, based on the highest tested concentration.

Table 3-14. Aquatic Invertebrate (Exposed in Sediment) Risk Quotients

Use Site	1-in-10 Yr EEC Pore Water (µg/L)/ Bulk Sediment (µg/kg-OC)[2]			Risk Quotients					
				Freshwater			Estuarine/marine		
				Acute	Chronic[1]		Acute	Chronic[1]	
	Daily Mean (PW)	21-day Mean		LC/EC$_{50}$ > 27,000 µg a.i./L[3]	NOAEC = 410 µg a.i./L[4]	NOAEC = 230,000 µg a.i./kg-OC[2,5]	LC/EC$_{50}$ = 290 µg a.i./L[3]*	NOAEC = 4,500 µg a.i./L[4]	NOAEC = 1,600,000 µg a.i./kg-OC[2,5]
		PW	BS						
Cotton, seed	3.4	3.4	1301	NC	0.01	0.01	0.01	<0.01	<0.01
Soybean, seed	1.9	1.9	731	NC	<0.01	<0.01	0.01	<0.01	<0.01
Lettuce, soil	4.2	4.2	1605	NC	0.01	0.01	0.01	<0.01	<0.01
Turf grass, foliar	11	11	4261	NC	0.03	0.02	0.04	<0.01	<0.01
Ornamentals, soil	14	14	5289	NC	0.03	0.02	0.05	<0.01	<0.01

EEC=estimated environmental concentration; NC = not calculated due to non-definitive toxicity endpoint

The LOC for acute risk to non-listed species is 0.5 or the chronic risk LOC is 1.0. *Italicized* values exceed the LOC for acute risk to listed species of 0.05. The endpoints listed in the table are the endpoints used to calculate the RQ.

*Based on shell deposition study.

[1] The EECs used to calculate this RQ are based on the 1-in-10-year 21-day average value from **Table 3-11**. The pore water EEC is listed first in µg/L and the organic-carbon normalized bulk sediment EEC is listed next in µg/kg-OC.

[2] The EECs used to calculate this RQ are based on OC-normalized values from **Table 3-11**. The bulk sediment EECs are divided by 0.04 to account for the 4% carbon content of the sediment for the EPA pond].

[3] Measured water-column LC$_{50}$ from the most sensitive water-column toxicity test for FW (48-hr LC$_{50}$ for Daphnid; MRID 51459432) and E/M (48-hr LC$_{50}$ for Oyster; MRID 51459434).

[4] Measured porewater NOAEC from the sediment toxicity test for FW (10-day NOAEC for *Chironomus dilutus*; MRID 51459444) and E/M (10-day NOAEC for *Leptocheirus plumulosus*; MRID 51459445.

[5] Measured organic carbon normalized bulk-sediment NOAEC from the sediment toxicity test for FW (10-day NOAEC for *Chironomus dilutus*; MRID 51459444) and E/M (10-day NOAEC for *Leptocheirus plumulosus*; MRID 51459445.).

3.5 Terrestrial Animal Risk Assessment

3.5.1 Terrestrial Vertebrate Exposure Assessment

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals by emphasizing the dietary exposure pathway. Cyclobutrifluram is applied through ground application methods, which includes sprayers, chemigation and soil drenching, as well as through seed treatments. Therefore, potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of cyclobutrifluram residues on food items following spray (foliar or soil) applications, and from possible dietary ingestion of cyclobutrifluram residues on treated seeds. EECs for birds[21] and mammals from consumption of dietary items on the treated field were calculated using T-REX v.1.5.2. Terrestrial wildlife may also be exposed through ingestion of residues in aquatic organisms. Exposure through this pathway was evaluated using KABAM version 1.

3.5.1.1 Dietary Items on the Treated Field

Terrestrial Vertebrate Analysis for Seed Treatment

Application rates for seed treatments (in terms of lb a.i./A) were presented in **Table 2-1**, and resulting EECs from T-REX v.1.5.2 for cyclobutrifluram treated seeds are provided in **Table 3-15** (below)**.** Results include Nagy dose-based values (i.e., mg a.i./kg-bw/day) and available mass of active ingredient per unit area (i.e., mg a.i./ft^2). Seed treatment exposure estimates are based not only on lb a.i./A allowed but on how many seeds are planted on a given acre. Seeding rates for cotton and soybean are based on the default values used in T-REX v.1.5.2 and represent national maximum values for each crop. Seed treatment exposures that result in RQ values that exceed the LOC are further evaluated to determine the number of seeds that need to be consumed to reach the LOC threshold (USEPA, 2016).

Table 3-15. Avian and Mammalian Dose-Based Estimated Environmental Concentrations (EECs) and mg a.i./ft2 EECs for Cyclobutrifluram Seed Uses

Crop	Animal Size	Maximum Application Rate	Maximum Seed Application Rate	Avian Nagy Dose	Mammalian Nagy Dose	Available AI
		(lb a.i./A)	(mg a.i./kg seed)	(mg a.i./kg-bw/day)	(mg a.i./kg-bw/day)	(mg a.i./ft^2)
Cotton[1]	Small	0.08	4496	1138	953	0.89
	Medium			649	658	
	Large			290	153	
Soybean[2]	Small	0.17[3]	990	251	210	1.7
	Medium			143	145	

[21] Birds are also used as a proxy for reptiles and terrestrial-phase amphibians.

Crop	Animal Size	Maximum Application Rate	Maximum Seed Application Rate	Avian Nagy Dose	Mammalian Nagy Dose	Available AI
		(lb a.i./A)	(mg a.i./kg seed)	(mg a.i./kg-bw/day)	(mg a.i./kg-bw/day)	(mg a.i./ft^2)
	Large			64	34	

[1] Based on a default seeding rate of 18.9 lb seed/A
[2] Based on a default seeding rate of 166.7 lb seed/A
[3] T-REX estimated value based on default seeding rate. This value is higher than the maximum application rate specified in the label for soybean seed treatments. This discrepancy appears to be due to the default seeding rate in T-REX, which is used for T-REX calculations, being much higher than the seeding rates indicated by label use instructions.

Table 3-16 shows the T-REX calculated RQs for birds and mammals exposed to cyclobutrifluram through treated seed consumption. For birds and mammals, acute dose-based RQs and LD_{50}/ft^2 RQs could not be calculated due to a non-definitive LD_{50} values. On a chronic basis, the RQ exceeds the LOC (1.0) for birds consuming treated cotton seed (RQ = **2.4**), but not treated soybean seed. On a chronic basis, the RQ exceeds the LOC (1.0) for mammals consuming treated cotton seed (RQ = **4.6** - **10**) and small and medium mammals consuming treated soybean seed (RQ = **1.9** - **2.2**). There is uncertainty around these LOC exceedances for birds and mammals, as the RQs were calculated based on endpoints from studies where no effects were observed up to the highest concentrations tested.

To determine the number of seeds needed to reach chronic toxicity levels (seed concern) for birds, the NOAEC is multiplied by the bird weight (small = 20g, medium = 100g, and large = 1000g). This weight adjusted NOAEC is then divided by the mass of cyclobutrifluram per seed (0.45 mg a.i./seed for cotton). In order to reach the chronic toxicity endpoint (NOAEC = 1899 mg a.i./kg-diet), small, medium, and large birds feeding on cotton seed would have to consume 84, 422, and 4220 seeds, respectively. Based on daily food consumption rates (g/day; obtained from Seed Treatments tab in T-REX version 1.5.2) and seed weight (based on number of seeds per pound presented on the product label; 3000 soybean seeds per pound and 4500 cotton seeds per pound), the percentage of diet needed to reach the seed concern is 170% for small birds, 304% for medium birds, and 656% for large birds. As consumption of greater than 100% of the daily diet would be needed to reach the seed concern for birds of all sizes, chronic risk from cotton seeds treated with cyclobutrifluram is expected to be low.

To determine the seed concern for mammals, the adjusted NOAEL calculated in T-REX for seed treatment uses is multiplied by the mammalian weight (small = 15g, medium = 35g, and large = 1000g). This weight adjusted NOAEL is divided by the mass of cyclobutrifluram per seed (0.45 mg a.i./seed for cotton and 0.15 mg a.i./seed for soybean). In order to reach the chronic toxicity endpoint (NOAEC = 43.10 mg a.i./kg-bw), small, medium, and large mammals feeding on cotton seed would have to consume 3 (10% of diet), 6 (12% of diet), and 74 (22% of diet) seeds, respectively. Small, medium, and large mammals feeding on soybean seed would have to consume 9 (45% of diet), 18 (54% of diet), and 221 (98% of diet) seeds, respectively. Based on the percentage of diet needed to reach the seed concern being less than 100% of the diet, risk to mammals from consumption of cyclobutrifluram treated cotton and soybean seeds is a potential concern, especially if seeds are attractive and left exposed on or near the surface.

Table 3-16. Acute Dose-Based, LD50/ft2 based and Chronic dose-based RQs for Birds and Mammals Exposed to Cyclobutrifluram Treated Seed

Crop	Risk Quotients (RQs)							
	Avian (LD_{50} >2000 mg a.i./kg-bw, NOAEC = 1899 mg a.i./kg-diet)				Mammalian (LD_{50} = >5,000 mg a.i./kg-bw, NOAEL = 43.10 mg a.i./kg-bw)			
	Animal Size	Acute Dose-Based	Acute LD_{50}/ft^2	Chronic	Animal Size	Acute Dose-Based	Acute LD_{50}/ft^2	Chronic
Cotton	20 g	NC	NC	**2.4**	15 g	NC	NC	**10**
	100 g	NC	NC		35 g	NC	NC	**8.6**
	1000 g	NC	NC		1000 g	NC	NC	**4.6**
Soybean	20 g	NC	NC	0.52	15 g	NC	NC	**2.2**
	100 g	NC	NC		35 g	NC	NC	**1.9**
	1000 g	NC	NC		1000 g	NC	NC	**1.0**

Bold values exceed acute LOC (0.5) and chronic LOC (1.0).
Chronic RQs are the same for all size classes since body weight toxicity endpoints are not scaled for avian species.
LD_{50}/ft^2 is the amount of pesticide estimated to kill 50% of exposed animals in each square foot of applied area.

Terrestrial Vertebrate Analysis for Broadcast Applications

Potential dietary exposure for terrestrial wildlife in this assessment is based on consumption of cyclobutrifluram residues on food items following spray (foliar and soil) applications, and from possible dietary ingestion of cyclobutrifluram residues on treated seeds. EECs for birds[22] and mammals from consumption of dietary items on the treated field were calculated using T-REX v.1.5.2. EECs are based on application rates, number of applications, and intervals presented in **Table 2-1**. For application methods, all broadcast methods were modeled as foliar applications, as a more conservative approach to evaluating exposure risk to terrestrial animals. For liquid applications to bare soil, arthropod and seed residues estimated from the Kenaga nomogram are possible dietary exposure routes on the field, and foliar residues estimate exposure adjacent to the field and that may occur with spray drift.

Upper-bound Kenaga nomogram values are used to derive EECs for cyclobutrifluram exposures to terrestrial mammals and birds on the field of application based on a 1-year time period. Consideration is given to different types of feeding strategies for mammal and birds, including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1,000 g) and three weight classes of mammals (15 g, 35 g, and 1,000 g). EECs on terrestrial food items range from 1.3 to 92.81 mg/kg-diet based on upper

[22] Birds are also used as a proxy for reptiles and terrestrial-phase amphibians.

bound Kenaga values. Dose base EECs, adjusted for body weight, range from 0.09 to 105.71 for birds and 0.05 to 88.49 for mammals. A summary of EECs is found in **Table 3-17**.

Table 3-17. Summary of Dietary (mg a.i./kg-diet) and Dose-based EECs (mg a.i./kg-bw) as Food Residues for Birds, Reptiles, Terrestrial-Phase Amphibians and Mammals from Labeled Uses of Cyclobutrifluram (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Dietary-Based EEC (mg/kg-diet)	Dose-Based EEC (mg/kg-body weight)					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Romaine Lettuce (0.089 lb a.i./acre, 1x)							
Short grass	21	24	14	6.2	20.37	14.08	3.26
Tall grass	9.8	11	6.4	2.9	9.33	6.45	1.50
Broadleaf plants/small insects	12	14	7.8	3.5	11.46	7.92	1.84
Fruits/pods/seeds (dietary only)	1.3	1.5	0.87	0.39	1.27	0.88	0.20
Arthropods	8.4	9.5	5.4	2.4	7.98	5.51	1.28
Seeds (granivore)[1]	NA	0.34	0.19	0.09	0.28	0.20	0.05
Ornamentals (0.187 lb a.i./acre, 2x, 14-day interval)							
Short grass	78.89	89.85	51.24	22.94	75.22	51.99	12.05
Tall grass	36.16	41.18	23.48	10.51	34.47	23.83	5.52
Broadleaf plants/small insects	44.38	50.54	28.82	12.90	42.31	29.24	6.78
Fruits/pods/seeds (dietary only)	4.93	5.62	3.20	1.43	4.70	3.25	0.75
Arthropods	30.90	35.19	20.07	8.98	29.46	20.36	4.72
Seeds (granivore)[1]	NA	1.25	0.71	0.32	1.04	0.72	0.17
Turf (0.22 lb a.i./acre, 2x, 14-day interval)							
Short grass	92.81	105.71	60.28	26.99	88.49	61.16	14.18
Tall grass	42.54	48.45	27.63	12.37	40.56	28.03	6.50
Broadleaf plants/small insects	52.21	59.46	33.91	15.18	49.78	34.40	7.98
Fruits/pods/seeds (dietary only)	5.80	6.61	3.77	1.69	5.53	3.82	0.89
Arthropods	36.35	41.40	23.61	10.57	34.66	23.95	5.55
Seeds (granivore)[1]	NA	1.47	0.84	0.37	1.23	0.85	0.20

EEC=estimated environmental concentration

[1] Seeds presented separately for dose - based EECs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

3.5.1.2 Exposure via Bioaccumulation

Based on a log K_{ow} of 3.2, cyclobutrifluram could have the potential to bioaccumulate. The KABAM model (K_{OW} (based) Aquatic BioAccumulation Model) version 1.0 was used to evaluate the potential exposure and risk of direct effects to birds and mammals via bioaccumulation and biomagnification in aquatic food webs. KABAM is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic ecosystems and risks to mammals and birds consuming aquatic organisms which have bioaccumulated these pesticides. The bioaccumulation portion of KABAM is based upon work by Arnot and Gobas (2004) who parameterized a bioaccumulation model based on PCBs and some pesticides (e.g., lindane, DDT) in freshwater aquatic ecosystems (Arnot and Gobas, 2004). KABAM relies on a chemical's octanol-water partition coefficient (K_{OW}) to estimate uptake and elimination constants through respiration and diet of organisms in different trophic levels. Pesticide tissue residues are calculated for organisms at different levels of an aquatic food web. The model then uses pesticide tissue concentrations in aquatic animals to estimate dose- and dietary-based exposures and associated risks to mammals and birds (surrogate for amphibians and reptiles) consuming aquatic organisms. Seven different trophic levels including phytoplankton, zooplankton, benthic invertebrates, filter feeders, small-sized (juvenile) forage fish, medium-sized forage fish, and larger piscivorous fish, are used to represent an aquatic food web. Importantly, chemical metabolism by biota is assumed to be zero in KABAM unless evidence indicates such metabolism is likely to affect the model predictions substantially.

Table 3-18. Bioaccumulation Model Input Values for Cyclobutrifluram

Parameter	Input Value	Source
Pesticide Name	Cyclobutrifluram	--
Log K_{OW}	3.2	MRID 51459902
K_{OC} (mL/g)	410	Mean K_{OC} value from MRID 51460215.
Pore water EEC (µg/L)	14	Maximum 1-in-10 year 1-day average value from surface water modeling. The estimated time to reach steady state was 3 days.
Water column EEC (µg/L)	15	

Based on KABAM results, estimated concentrations of cyclobutrifluram residues in the tissue of organisms in the different trophic levels following foliar application on ornamentals range from 583 to 1,143 µg/kg-tissue (**Table 3-19**). The measured bioconcentration potential in whole fish of cyclobutrifluram in bluegill sunfish was 31 L/kg-wet-weight (MRID 51459430) and is lower than BCF values estimated in KABAM modeling. The maximum total BCF from KABAM was 77 L/kg-wet weight in the whole fish, which is higher than what was measured. This could be due to metabolism of cyclobutrifluram in fish or variability in BCF measurements.

Table 3-19. KABAM Predicted Concentrations of Cyclobutrifluram in Aquatic Organism Tissues at Different Trophic Levels (µg/kg-wet weight)

Use Scenario	Phytoplankton	Zooplankton	Benthic Invertebrates	Filter Feeders[1]	Small Fish	Medium Fish	Large Fish
Ornamentals, soil MI Nursery (0.187 lb a.i./A)	1,101	809	879	583	1,130	1,133	1,143

[1] Filter feeders include clams, krill, sponges, whales, and many fish and may be vertebrates or invertebrates.

3.5.2 Terrestrial Vertebrate Risk Characterization

3.5.2.1 Terrestrial Diet Exposure (T-REX)

No treatment related effects were observed in any acute or chronic avian studies. RQ values (**Table 3-20)** are generated based on the upper bound EECs discussed above and toxicity values contained in **Table 3-5**.

For acute dose- and dietary-based exposure for birds, RQ values could not be calculated, due to non-definitive endpoints. The LD_{50} (>2000 mg a.i./kg-bw) is an order of magnitude higher than the highest dose-based EEC (105.71 mg/kg-bw) for turf use. The LC_{50} (>5245 mg a.i./kg-diet) is at least 50X higher than the highest dietary-based EEC (92.81 mg/kg-diet). For chronic exposures for birds, dietary based RQs based on the highest concentration tested (1899 mg a.i./kg-diet) range from <0.01 to 0.05.

Table 3-20. Acute and Chronic RQ values for Birds, Reptiles, and Terrestrial-Phase Amphibians from Labeled Uses of Cyclobutrifluram (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ[2] LD_{50} > 2000 mg a.i./kg-bw			Acute Dietary-Based RQ[3] LC_{50} > 5245 mg a.i./kg-diet	Chronic Dietary RQ[4] NOAEC = 1899 mg a.i./kg-diet
	Small (20 g)	Medium (100 g)	Large (1000 g)		
Romaine Lettuce (0.089 lb a.i./acre, 1x)					
Herbivores/Insectivores					
Short grass	NC	NC	NC	NC	0.01
Tall grass	NC	NC	NC	NC	0.01
Broadleaf plants	NC	NC	NC	NC	0.01
Fruits/pods/seeds	NC	NC	NC	NC	<0.01
Arthropods	NC	NC	NC	NC	<0.01
Granivores					
Seeds[1]	NC	NC	NC	N/A	N/A
Ornamentals (0.187 lb a.i./acre, 2x, 14-day interval)					
Herbivores/Insectivores					
Short grass	NC	NC	NC	NC	0.04
Tall grass	NC	NC	NC	NC	0.02
Broadleaf plants	NC	NC	NC	NC	0.02
Fruits/pods/seeds	NC	NC	NC	NC	<0.01

Food Type	Acute Dose-Based RQ[2] LD50 > 2000 mg a.i./kg-bw			Acute Dietary-Based RQ[3] LC_{50} > 5245 mg a.i./kg-diet	Chronic Dietary RQ[4] NOAEC = 1899 mg a.i./kg-diet
	Small (20 g)	Medium (100 g)	Large (1000 g)		
Arthropods	NC	NC	NC	NC	0.02
Granivores					
Seeds[1]	NC	NC	NC	N/A	N/A
Turf (0.22 lb a.i./acre, 2x, 14-day interval)					
Herbivores/Insectivores					
Short grass	NC	NC	NC	NC	0.05
Tall grass	NC	NC	NC	NC	0.02
Broadleaf plants	NC	NC	NC	NC	0.03
Fruits/pods/seeds	NC	NC	NC	NC	<0.01
Arthropods	NC	NC	NC	NC	0.02
Granivores					
Seeds[1]	NC	NC	NC	N/A	N/A

NC = not calculated due to non-definitive toxicity endpoint; N/A = Not applicable
The LOC for acute risk to non-listed species is 0.5 or the chronic risk LOC is 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.
[1] Seeds presented separately for dose - based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.
[2] Measured LD_{50} from acute toxicity test with Bobwhite quail (*Colinus virginianus*; MRID 51459413)
[3] Measured LC_{50} from acute toxicity test with Mallard (*Anas platyrhynchos*; MRID 51459421).
[4] Measured NOAEC from chronic toxicity test with Bobwhite quail (*Colinus virginianus*; MRID 51459419).

No treatment related effects were observed in the acute toxicity study for mammals. For acute dose-based exposure for mammals, RQ values could not be calculated, due to a non-definitive endpoint. The LD_{50} (>5000 mg a.i./kg-bw) is at least 56X higher than the highest dose-based EEC (88.49 mg/kg-bw) for turf use.

No treatment related effects were observed in the chronic 2-generation reproduction toxicity study for mammals. For chronic dose-based exposure for mammals, RQ values (**Table 3-21**) ranged from <0.01 - 0.93 for proposed uses on romaine, turf, and ornamentals. Chronic dietary-based RQs ranged from <0.01 - 0.11.

Table 3-21. Chronic RQ values for Mammals from Labeled Uses of Cyclobutrifluram (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Chronic Dose-Based RQ NOAEL = 43.10 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 862 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Romaine Lettuce (0.089 lb a.i./acre, 1x)				
Herbivores/Insectivores				
Short grass	0.21	0.18	0.10	0.02
Tall grass	0.10	0.08	0.05	0.01
Broadleaf plants	0.12	0.10	0.06	0.01
Fruits/pods/seeds	0.01	0.01	0.01	<0.01
Arthropods	0.08	0.07	0.04	0.01

Food Type	Chronic Dose-Based RQ NOAEL = 43.10 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 862 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Granivores				
Seeds[1]	<0.01	<0.01	<0.01	N/A
Ornamentals (0.187 lb a.i./acre, 2x, 14-day interval)				
Herbivores/Insectivores				
Short grass	0.79	0.68	0.36	0.09
Tall grass	0.36	0.31	0.17	0.04
Broadleaf plants	0.45	0.38	0.20	0.05
Fruits/pods/seeds	0.05	0.04	0.02	0.01
Arthropods	0.31	0.27	0.14	0.04
Granivores				
Seeds[1]	0.01	0.01	0.01	N/A
Turf (0.22 lb a.i./acre, 2x, 14-day interval)				
Herbivores/Insectivores				
Short grass	0.93	0.80	0.43	0.11
Tall grass	0.43	0.37	0.20	0.05
Broadleaf plants	0.53	0.45	0.24	0.06
Fruits/pods/seeds	0.06	0.05	0.03	0.01
Arthropods	0.37	0.31	0.17	0.04
Granivores				
Seeds[1]	0.01	0.01	0.01	N/A

N/A = Not applicable

The LOC for chronic risk is 1.0. The endpoints listed in the table are the endpoints used to calculate the RQ.

[1] Seeds presented separately for dose – based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

[2] Measured NOAEL and NOAEC from 2-generation reproduction toxicity test with Laboratory rat (Rattus norvegicus; MRID 51460033).

3.5.2.2 Aquatic Dietary Exposure (KABAM)

KABAM was used to calculate RQ values from a bioaccumulation pathway for food items that may be consumed by birds and mammals for the modeled scenario of cyclobutrifluram resulting in the highest aquatic EEC (MI Nursery) as described in **Section 3.5.1.2.** Results of the risk estimation for birds and mammals consuming contaminated aquatic prey species are provided in **Table 3-22**. Since the acute toxicity values for birds and mammals are non-definitive, acute RQ values were not calculated. Chronic dietary-based risk to aquatic-dependent birds and mammals is not indicated, as all chronic dietary-based RQs are <0.01. For chronic dose-based risk to mammals, risk is expected to be low; all RQs are well below the chronic risk LOC of 1.0 at 0.01.

Table 3-22. Acute and Chronic Risk Quotient (RQ) Values for Birds and Mammals Consuming Aquatic Prey that has Bioaccumulated Cyclobutrifluram based on the Maximum Exposure Scenario (TN Nursery) using the K_{ow} [based] Aquatic Bioaccumulation Model (KABAM).

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose-Based	Dietary-Based
Mammalian Species[1]				
fog/water shrew	NC	N/A	0.01	<0.01
rice rat/star-nosed mole	NC	N/A	0.01	<0.01
small mink	NC	N/A	0.01	<0.01
large mink	NC	N/A	0.01	<0.01
small river otter	NC	N/A	0.01	<0.01
large river otter	NC	N/A	0.01	<0.01
Avian Species[2]				
sandpipers	NC	NC	N/A	<0.01
cranes	NC	NC	N/A	<0.01
rails	NC	NC	N/A	<0.01
herons	NC	NC	N/A	<0.01
small osprey	NC	NC	N/A	<0.01
white pelican	NC	NC	N/A	<0.01

NC = not calculated due to non-definitive toxicity endpoint; N/A = Not applicable

[1] Based on a chronic, 2-generation dietary NOAEL of 43.1 mg/kg-bw/day for the Laboratory Rat (*Rattus norvegicus*; MRID 51460033)

[2] Based on a chronic reproduction NOAEC of 1899 mg/kg-diet for Bobwhite Quail (*Colinus virginianus*; MRID 51459419).

3.5.3 Terrestrial Invertebrate Risk Assessment

3.5.3.1 Bee Exposure Assessment

The list of crops to which cyclobutrifluram is applied is listed in **Table 3-23** along with the United States Department of Agriculture (USDA) pollinator attractive data (USDA, 2018) to identify which crops may represent direct exposure to pollinators on the field. Off-field assessments are conducted for foliar sprays regardless of whether the crop is attractive or not. Bees (both Apis and non-Apis) may be exposed on and off the field to all use sites, except lettuce which is harvested before bloom, and therefore the potential for on-field risk was not further evaluated.

Table 3-23. Summary of Information on the Attractiveness of Registered Use Patterns for Cyclobutrifluram to Bees[23]

Crop Name	Honey Bee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.	Notes
Cotton, (*Gossypium hirsutum*; *G. barbardense*))	Y (nectar)[1]	Yes[1]	Yes[1] (*Halictus, Anthophora, Xylocopa, Megachile, Nomia, Ptilothrix*)	7,664,400	Does not require bee pollination or use managed pollinators, but cotton is used by some beekeepers for honey production.
Lettuce (*Latuca sativa*)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	259,100 Head, Leaf and Romaine	Does not require bee pollination or use managed pollinators; harvested prior to bloom; self-pollinating
Soybean, (*Glycine soja*)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	75,869,000	Does not require bee pollination or use managed pollinators.
Residential turf	Yes	Yes	Yes	--	Potential bee attractive weeds on residential turf.
Ornamentals	Yes	Yes	Yes	--	Ornamentals are assumed to be attractive.

[1] USDA (2018) attractiveness rating indicates use pattern is opportunistically attractive to bees.

3.5.3.2 Bee Tier I Exposure Estimates

Contact and dietary exposure are estimated separately using different approaches specific for different application methods. The Bee-REX model (Version 1.0) calculates default (*i.e.*, high end, yet reasonably conservative) EECs for contact and dietary routes of exposure for foliar, soil, and seed treatment applications. The approach used for T-REX modeling, assessing all broadcast application methods as foliar (**Section 3.5.2.1**), was not utilized for assessing risk to bees, as romaine lettuce is self-pollinated and harvested before bloom, and ornamentals modeled as foliar applications within Bee-REX resulted in chronic adult and larval RQs (see turf RQs) that exceed the LOC for bees. Additional information on bee-related exposure estimates, and the calculation of risk estimates in Bee-Rex can be found in the *Guidance for Assessing Risk to Bees* (USEPA *et al.*, 2014).

In cases where the Tier I RQs exceed the LOC, discussed below, estimates of exposure may be refined using measured pesticide concentrations in pollen and nectar of treated crops (provided measured residue data are available), and further calculated for other castes of bees using their food consumption rates as summarized in the White Paper to support the Scientific Advisory Panel (SAP) on the pollinator risk assessment process (USEPA, 2012b).

[23] USDA. 2018. Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen. Available at: https://www.usda.gov/sites/default/files/documents/Attractiveness-of-Agriculture-Crops-to-Pollinating-Bees-Report-FINAL-Web-Version-Jan-3-2018.pdf

3.5.3.3 Bee Risk Characterization (Tier I)

Tier I Risk Estimation (Contact Exposure)

On-Field Risk

Because potential exposure of bees is identified based on the pollinator attractiveness of cotton, soybean, lettuce, residential turf, and ornamentals both on and off the treated field, the next step in the risk assessment process is to conduct a Tier 1 risk assessment. By design, the Tier 1 assessment begins with (high-end) model-generated (foliar and soil treatments) or default (seed treatments) estimates of exposure via contact and oral routes. For contact exposure, only the adult (forager and drones) life stage is considered since this is the relevant life stage for honey bees (*i.e.*, since other bees are in-hive, the presumption is that they would not be subject to contact exposure). Furthermore, toxicity testing protocols have only been developed for acute exposures. Effects are defined by laboratory exposures to groups of individual bees (which serve as surrogates for solitary non-*Apis* bees and individual social non-*Apis* bees).

On the basis of acute contact exposure to adult honey bees, RQs could not be calculated due to the adult honey bee contact study resulting in a non-definitive endpoint due to lack of significant toxicity within the study. A summary of acute contact doses for adult honey bees are provided in **Table 3-24**.

Table 3-24. Default Tier I Adult, Acute Contact Risk Quotients for Honey Bees Foraging on Crops Treated with Cyclobutrifluram from BeeRex (ver. 1.0)

Use Pattern	Max. Single Application Rate (lb a.i./A)	Dose (μg a.i./bee per 1 lb a.i./A)	Cyclobutrifluram Contact Dose (μg a.i./bee)	Acute RQ[1]
Cotton; Soybean	0.085	2.7	0.23	NC
Ornamentals	0.187	2.7	0.50	NC
Turf	0.22	2.7	0.59	NC

NC = not calculated due to non-definitive toxicity endpoint

[1] Based on a 48-h acute contact LD50 of >200 µg a.i./bee for Cyclobutrifluram (MRID 51459447).

Tier I Risk Estimation (Oral Exposure)

On-Field Risk

For oral exposure, the Tier 1 assessment considers just the caste of bees with the greatest oral exposure (foraging adults). If risks are identified, then other factors are considered for refining the Tier 1 risk estimates. These factors include other castes of bees and available information on residues in pollen and nectar which is deemed applicable to the crops of interest. These exposure data may have been collected on surrogate crops (*e.g.*, phacelia, buckwheat, alfalfa) which are known to be attractive sources of both pollen and nectar for bees). Only one study was conducted to assess residues in pollen and nectar (MRID 51459450). As this study was conducted as a soil application to cucumber plants and the only exceedance for honey bees is based on turfgrass foliar applications, refinements based on residues in pollen and nectar are not appropriate with the available data.

On the basis of acute oral exposure to adult nectar foragers and larval worker honey bees, RQs could not be calculated, as the submitted studies resulted in non-definitive endpoints due to lack of toxicity at the highest treatment levels. On the basis of chronic oral exposure to adult nectar-foragers and larval worker honey bees, RQs range from 0.01 to **1.2** and 0.13 to **19**, respectively. Based on these analyses, acute RQs do not exceed the LOC for adult foragers and/or larval worker honey bees for any use pattern. Chronic RQs generated for turf uses exceed the LOC for adult foragers and/or larval worker honey bees. Chronic oral risk for adult honey bees is potentially overestimated, as a non-definitive toxicity endpoint is used in the calculation. A summary of acute/chronic oral RQs for adult foragers and larval worker honey bees are provided in **Table 3-25**.

While the chronic RQ values for honey bee oral exposures exceed the LOC of 1.0, the potential for exposure is considered low due to proposed bloom restrictions on the product label for turfgrass, which do not allow for applications of cyclobutrifluram when flowering/blooming weeds and plants are present.

Table 3-25. Tier 1 (Default) Oral Risk Quotients for Adult Nectar Forager and Larval Worker Honey Bees from BeeRex (ver. 1.0)

Use Pattern	Max. Single Appl. Rate (lb a.i./A)	Bee Caste/Task	Oral Dose (µg a.i./bee)	Acute Oral RQ[1]	Chronic Oral RQ[2]
Cotton; Soybean (seed)	0.085	Adult nectar forager	0.29	NC	0.05
		Larval worker	0.12	NC	0.77
Turf (foliar)	0.22	Adult nectar forager	7.1	NC	**1.2**
		Larval worker	3.0	NC	**19**

Use Pattern	Max. Single Appl. Rate (lb a.i./A)	Bee Caste/Task	Oral Dose (µg a.i./bee)	Acute Oral RQ[1]	Chronic Oral RQ[2]
Ornamentals (soil)	0.187	Adult nectar forager	0.048	NC	0.01
		Larval worker	0.020	NC	0.13

NC = not calculated due to non-definitive toxicity endpoint
Bolded RQ value exceeds (or potentially exceeds) the acute risk LOC of 0.4 or chronic LOC of 1.0.
[1] Based on a 48-h acute oral LD_{50} of >72.23 µg a.i./bee for adults (MRID 51459447) and 72-h LD_{50} of >30.9 µg a.i./bee for larvae (MRID 51459452).
[2] Based on a 10-d chronic NOAEL of 5.9 µg a.i./bee/d for adults (MRID 51459451) and a 22-d chronic NOAEL of 0.16 µg a.i./bee/d for larvae (MRID 51459453).

Off-Field Risk

In addition to bees foraging on the treated field, bees may also be foraging in fields adjacent to the treated fields. Since risks from chronic oral exposures to adult and larval honey bees are indicated on-field, analysis of risk due to spray drift off the treated field was conducted. Using label specifications for ground applications to turf (foliar), AgDRIFT® was run to estimate the extent to which risk to bees extends beyond the edge of the treated areas (**Table 3-26**). The highest risk for off-field exposure is for larval honey bees following foliar ground applications at 0.22 lb a.i./A to turf; the potential for exposure to cyclobutrifluram at concentrations that would exceed the level of concern can occur 3 - 10 ft from the edge of the treated field. Limitations to allowed droplet size and boom height could further minimize these off-field distances.

Table 3-26. AgDRIFT™ Off-Field Risk Estimates for Cyclobutrifluram.

Bee Stage	Application Rate (lb a.i./A)	Application Method	Boom Height[1]	Droplet Size	Distance from Field to Point of Chronic LOC (ft)[2]
Adult (Foliar)	0.22	Ground	High	Fine to Medium/Coarse	3
			Low		3
Larval (Foliar)	0.22		High		10
			Low		7

[1]Low Boom height = 20 inches from the soil surface; High Boom height = 50 inches from the soil surface
[2]Distance to where RQ values drop below the chronic risk level of concern (LOC) of 1.0; based on an adult bee 10-d chronic NOAEL of 5.9 µg a.i./bee/d (MRID 51459451) and a larval bee 22-d chronic NOAEL of 0.16 µg a.i./larva/d (MRID 51459453).

3.5.3.4 Other Terrestrial Invertebrates

Several studies assessing the effects of the active ingredient cyclobutrifluram on terrestrial invertebrates other than honey bees were submitted in support of this new chemical registration. These studies offer insight into potential effects of cyclobutrifluram exposure on non-target beneficial insects and other terrestrial invertebrates. **Table 3-27** summarizes the conclusions from the available studies. No significant effects to mortality were noted across the submitted studies, and effects to growth were only noted in the earthworm subchronic study.

Overall, effects to reproduction seem to be most noteworthy among these additional terrestrial invertebrate studies. Significant effects to total number of juveniles were determined in three sub-lethal reproduction studies for the earthworm conducted using the TGAI and two TEP formulations. MRID 51459455 is not suitable for risk estimation, but the results show the number of eggs laid per female was significantly reduced in the lowest assessed test level in the Predatory Mite *Typhlodromus pyri* 14 days after exposure; this study has a non-definitive NOAEC for reproduction at 0.15 lb a.i./A, which is lower than the highest proposed single maximum application rate for turf and ornamentals.

Table 3-27. Non-Target Terrestrial Invertebrates

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value	MRID or ECOTOX No.	Comments
Earthworm Acute	TGAI (80.3)	Earthworm *(Eisenia andrei)*	14d Mortality & Growth NOAEC = 500 mg a.i./kg dw soil	51459470 Acceptable	↑68% Body weight change at the LOAEC
Earthworm Sub-Lethal Reproduction	TGAI (80.3)	Earthworm *(E. andrei)*	28d Mortality & Growth LC_{50} > 1000 mg a.i./kg dw soil NOAEC = 1000 mg a.i./kg dw soil 56d Reproduction EC_{50} = 536 mg a.i./kg dw soil NOAEC = 171 mg a.i./kg dw soil	51459471 Acceptable	↓23% # juveniles at the LOAEC
	TEP SC (38.1)	Earthworm *(E. andrei)*	28d Mortality & Growth LC_{50} > 1000 mg a.i./kg dw soil NOAEC = 1000 mg a.i./kg dw soil 56d Reproduction EC_{50} = 225 mg a.i./kg dw soil NOAEC = 118 mg a.i./kg dw soil	51459458 Acceptable	↓40% # juveniles at the LOAEC
	TEP FS (41.4)	Earthworm *(E. andrei)*	28d Mortality & Growth LC_{50} > 1000 mg a.i./kg dw soil NOAEC = 1000 mg a.i./kg dw soil 56d Reproduction EC_{50} = 279 mg a.i./kg dw soil NOAEC = 70.8 mg a.i./kg dw soil	51459459 Acceptable	↓21% # juveniles at the LOAEC
Parasitic Wasp Mortality & Reproduction	TEP SC (38.1)	Parasitic Wasp (*Aphidius rhopalosiphi*)	48h LC_{50} > 672 g a.i./ha *(0.60 lb a.i./A)* 11d Reproduction EC_{50} > 672 g a.i./ha NOAEC = 672 g a.i./ha	51459454 Supplemental	Residues on glass plates. ↑16% mortality in highest test level. Reproduction not measured in two lowest test levels. Study is suitable for quantitative use.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value	MRID or ECOTOX No.	Comments
Mite Mortality & Reproduction	TEP SC (38.1)	Predatory Mite (*Typhlodromus pyri*)	7d Mortality LC_{50} > 672 g a.i./ha 14d Reproduction EC_{50} > 672 g a.i./ha NOAEC < 168 g a.i./ha *(0.15 lb a.i./A)*	51459455 Supplemental	Residues on glass plates. ↑12% mortality in second lowest test level; non-monotonic response. ↓46% eggs/female at third lowest test level. **Undefined NOAEC**. Reproduction not measured in two lowest test levels; inverse dose response in three highest levels. Study is suitable for qualitative use only.
Mite Mortality & Reproduction	TEP FS (41.4)	Predatory Mite (*Hypoaspis aculeifer*)	14d Mortality LC_{50} > 414 mg a.i./kg dw soil 14d Reproduction EC_{50} > 414 mg a.i./kg dw soil NOAEC = 414 mg a.i./kg dw soil	51459456 Supplemental	Artificial soil substrate No significant effects. Study is suitable for quantitative use.

3.5.3.5 Characterization of Risk for Listed Terrestrial Invertebrates other than Honey Bees

For terrestrial invertebrates other than honey bees, listed RQs are calculated to determine potential impacts from contact (from soil, spray droplets, and treated surfaces) and dietary (plant tissue and other terrestrial invertebrates) exposures not included in the taxa-based assessment.

Characterization of Contact Exposure and Effects to Listed Terrestrial Invertebrates

Potential contact exposures from soil, spray droplets, and treated surfaces are all assessed individually. Appropriate EECs for each specific exposure pathway and toxicity endpoints from relevant studies and taxa are used to calculate listed RQs for each method of contact exposure. These RQs are based on minimal data, due to the limited availability of registrant submitted studies for terrestrial invertebrates. Evaluation of contact exposure, reported in more detail below, indicates estimated exposure is well below the toxicity thresholds determined by the currently available studies for soil, spray droplet, and treated surface exposures.

The maximum likely exposure level of soil organisms to cyclobutrifluram is presented in **Table 3-28**. The exposure level is calculated by a method distributing the applied chemical throughout the topsoil layer. This method assumes the earthworm or other soil-dwelling organisms generally inhabit the top 15 cm of soil. If an organism primarily inhabits deeper layers, then the EECs would be lower. The conservatively protective calculation assumes no degradation, therefore these exposure levels apply to any duration of exposure. Since cyclobutrifluram is persistent in soil (half-life range: 150 – 1097 days), a procedure accounting for its degradation in soil would only result in modestly lower EECs for longer durations of exposure.

Table 3-28. Estimated Environmental Cyclobutrifluram Concentrations for Soil Organisms.

Use Sites	App (lb a.i./ A)	Depth (cm)	Soil Bulk Density, g/cm^3	Wt of 15cm Acre layer (lbs)	Pesticide in Soil (mg/kg-soil; 15cm layer)
Turf	0.22	15	1.55	2073387	0.11
Ornamentals	0.187				0.090
Cotton or Soybean	0.085				0.041
Romaine Lettuce	0.089				0.043

[1] Abbreviations: **App** = Application; **cm** = centimeters; **wt** = weight
The bulk density assumption taken for a sandy loam soil from:
https://www.nrcs.usda.gov/sites/default/files/2022-11/Bulk%20Density%20-%20Soil%20Health%20Guide_0.pdf

The highest soil EEC for turf use, presented in **Table 3-28**, is compared to the toxicity endpoints from the earthworm (*Eisenia andrei*) and predatory mite (*Hypoaspis aculeifer*) studies presented in **Table 3-27**. For these studies, the estimated concentration of cyclobutrifluram in soil is 2-3 orders of magnitude lower than the available NOAECs for soil invertebrates (**Table 3-29**). This indicates that effects to soil dwelling invertebrates are not reasonably certain to occur from soil exposure.

Table 3-29. Soil Contact Exposure Listed RQs for Listed Terrestrial Invertebrates based on Cyclobutrifluram Uses on Turf.

Test Species: Study Type	Test Substance	Test Species	Toxicity Value	Listed RQ[1]
Earthworm: Subchronic	TGAI	Earthworm (*Eisenia andrei*)	14d NOAEC = 500 mg a.i./kg dw soil	<0.01
Earthworm: Sub-Lethal Reproduction	TGAI		56d NOAEC = 171 mg a.i./kg dw soil	<0.01
	TEP SC		56d NOAEC = 118 mg a.i./kg dw soil	<0.01
	TEP FS		56d NOAEC = 70.8 mg a.i./kg dw soil	<0.01
Mite: Mortality & Reproduction	TEP FS	Predatory Mite (*Hypoaspis aculeifer*)	14d NOAEC = 414 mg a.i./kg dw soil	<0.01

[1] RQ calculated using the highest soil EEC of 0.106 mg/kg-soil for proposed use on turf at the maximum application rate (0.22 lb a.i./A).

For estimating risk for terrestrial invertebrates from contact with spray droplets containing cyclobutrifluram, the T-REX dietary-based arthropod EEC for turf use, the use with the highest single application rate (0.22 lb a.i./A), is compared to the honey bee toxicity endpoint for contact exposure (MRID 51459447). As there were no significant effects observed in the study, the toxicity endpoint for the honey bee is non-definitive (LD_{50} > 1563 mg a.i./kg-bee; NOAEC = 1563 mg a.i./kg-bee), so a definitive listed RQ cannot be calculated. Estimated exposure (36 mg a.i./kg-bee) is 2 orders of magnitude lower than the NOAEC. Estimated exposure is well below the tested levels where no effects were observed in honey bees from contact exposure. Therefore, effects from contact exposure with spray droplets are not reasonably certain to occur.

For contact with treated surfaces, the toxicity endpoints from the parasitic wasp (*Aphidius rhopalosiphi*) study, conducted using glass plates, are compared to the highest single application rate. The NOAEC (0.60 lb a.i./A) is 2.7X higher than the maximum single application rate for turf use, 0.22 lb a.i./A (**Table 3-30**). In other words, estimated exposure is below the tested levels where no effects were observed. Therefore, effects from contact exposure with treated surfaces are not reasonably certain to occur.

Table 3-30. Treated Surface Contact Exposure Listed RQs for Listed Terrestrial Invertebrates.

Test Species: Study Type	Toxicity Value	Acute Exposure/Toxicity Ratio	Listed RQ[1]
Parasitic Wasp (*Aphidius rhopalosiphi*) Mortality & Reproduction	48h LC50 > 0.60 lb a.i./A 11d NOAEC = 0.60 lb a.i./A	NC	0.37

[1] RQ calculated using the maximum proposed application rate of 0.22 lb a.i./A.

Characterization of Dietary Exposure and Effects to Listed Terrestrial Invertebrates

Estimating potential dietary exposures for listed terrestrial invertebrates relies on the submitted data for honey bees (**Table 3-31**), due to the lack of more sensitive dietary endpoints for other terrestrial invertebrates. Terrestrial invertebrate dietary items of concern for this portion of the assessment include plant tissues (excluding pollen and nectar) and other terrestrial invertebrate prey.

Table 3-31. Dietary-Based Toxicity Endpoints for Honey Bees.

Study Type		Toxicity Value (mg a.i./kg diet)			
		LD_{50}	NOAEC	LOAEC	MATC
Adult[1]	Acute	>3612			
	Chronic		388	>388	NC
Larval[2]	Acute	>933			
	Chronic		4.1	11	6.8

[1] Based on a 48-h acute oral study (MRID 51459447) and a 10-d chronic study for adult honey bees (MRID 51459451).
[2] Based on a 72-h acute study (MRID 51459452) and a 22-d chronic study for larval honey bees (MRID 51459453; Day 15 Mortality ↑33% and Adult Emergence ↓41% at the LOAEC).

For applications to bare soil (romaine) and seed treatments (cotton and soybean), dietary risks are primarily based on the potential uptake of cyclobutrifluram, which is reported to be systemic, into plant tissues after application. As crop fields generally undergo maintenance prior to transplant and/or seeding, the presence of terrestrial invertebrate prey on-field during application of cyclobutrifluram for romaine, cotton, and soybean seeds is expected to be negligible. Dietary risk to listed terrestrial invertebrates from consumption of terrestrial invertebrate prey on the field during bare soil and treated seed applications is not reasonably certain to occur. EECs from Bee-REX are used to represent the concentration of cyclobutrifluram in plant tissues due solely to uptake (**Table 3-32**). Based on the EECs and the dietary toxicity endpoints for honey bees, there are no LOC exceedances for listed terrestrial invertebrate (excludes bees) dietary exposures from the proposed romaine, cotton, and soybean uses. Effects from acute and chronic dietary exposure to listed terrestrial invertebrates from bare soil applications and seed treatments are not reasonably certain to occur.

Table 3-32. Chronic Oral Listed RQs for Listed Terrestrial Herbivorous Invertebrates Exposed to Cyclobutrifluram following Bare Soil and Seed Treatment Applications.

Use	Bee-Rex EEC (mg a.i./kg)	Life Stage	Listed RQ (NOAEC)	Listed RQ (MATC)
Romaine	0.078	Adult[1]	<0.01	NC
		Larval[2]	0.02	0.01
Cotton and Soybean	1.0	Adult[1]	<0.01	NC
		Larval[2]	0.24	0.15

[1] Based on a 10-d chronic study for adult honey bees (MRID 51459451). Toxicity endpoints presented in **Table 3-31**.
[2] Based on a 22-d chronic study for larval honey bees (MRID 51459453). Toxicity endpoints presented in **Table 3-31**.

For use sites where the application of cyclobutrifluram occurs with dietary items present on the treated field, turf and ornamentals, the T-REX dietary EECs for tall grass, broadleaf plants, and arthropods are used to estimate risk to listed terrestrial invertebrates (**Table 3-33** and **Table 3-34**). Listed RQs for acute dietary risk cannot be calculated as all acute toxicity endpoints were non-definitive, but mortality from acute exposures is not reasonably certain to occur for both adult and larval life stages. In **Table 3-33**, upper bound Kenaga dietary EECs are used to calculate chronic listed RQs based on the NOAEC and MATC to estimate individual and population-level risk potential, respectively. Based on this comparison, effects to adult terrestrial invertebrates from chronic exposures are not reasonably certain to occur. This is because EECs are below the chronic honey bee NOAEC. For larvae, all listed RQs for chronic exposures exceed the listed LOC (1.0) for terrestrial invertebrates. As using the upper bound EEC is a conservative approach, chronic listed RQs are similarly calculated using the mean Kenaga EECs from T-REX (**Table 3-34**) to further investigate the potential for population-level effects to listed terrestrial invertebrates. When considering refinements of exposure and the MATC, chronic listed RQs for listed terrestrial invertebrate larvae exceed the chronic listed LOC of 1.0. EFED estimated exposures directly on the treated turf and ornamental use sites. When spray drift is considered, potential effects are not reasonably certain to occur off of the treated site because spray drift deposition results in exposures below the NOAEC. In the BE (**Section 4**), EFED considers life history information for listed terrestrial invertebrates due to the potential concern for effects on treated turf and ornamental use sites for larval life stages of listed terrestrial invertebrates. Any species where the larvae are not expected to occur on these sites are not expected to have impacts. Dietary items of concern include broadleaves, grasses, and arthropods. This chronic exposure concern does not include currently listed bee species, as currently listed bees primarily consume pollen and nectar, which are not dietary items of concern based on use sites and bloom restrictions on the proposed labels.

Table 3-33. Chronic Oral Listed RQs for Listed Terrestrial Herbivorous and Insectivorous Invertebrates Exposed to Cyclobutrifluram (Upper Bound Kenaga EECs).

Use [Dietary EECs (TG;B;A)]	Life Stage	Dietary Item					
		Tall Grass		Broadleaf Plants		Arthropods	
		Listed RQ (NOAEC)	Listed RQ (MATC)	Listed RQ (NOAEC)	Listed RQ (MATC)	Listed RQ (NOAEC)	Listed RQ (MATC)
Turf [43;52;36 ppm]	Adult[1]	0.11	NC	0.13	NC	0.09	NC
	Larval[2]	**10**	**6.3**	**13**	**7.7**	**8.8**	**5.4**
Ornamentals [36;44;31 ppm]	Adult[1]	0.09	NC	0.11	NC	0.08	NC
	Larval[2]	**8.8**	**5.3**	**11**	**6.6**	**7.5**	**4.6**

TG=Tall Grass; **B**=Broadleaf Plants; **A**=Arthropods; **NC**=MATC could not be calculated due to non-definitive LOAEC
[1] Based on a 10-d chronic study for adult honey bees (MRID 51459451). Toxicity endpoints presented in **Table 3-31**.
[2] Based on a 22-d chronic study for larval honey bees (MRID 51459453). Toxicity endpoints presented in **Table 3-31**.

Table 3-34. Chronic Oral Listed RQs for Listed Terrestrial Herbivorous and Insectivorous Invertebrates Exposed to Cyclobutrifluram (Mean Kenaga EECs).

Use [Dietary EECs (TG;B;A)]	Life Stage	Dietary Item					
		Tall Grass		Broadleaf Plants		Arthropods	
		Listed RQ (NOAEC)	Listed RQ (MATC)	Listed RQ (NOAEC)	Listed RQ (MATC)	Listed RQ (NOAEC)	Listed RQ (MATC)
Turf [14;17;25 ppm]	Adult[2]	0.04	NC	0.05	NC	0.07	NC
	Larval[3]	**3.4**	**2.1**	**4.2**	**2.6**	**6.1**	**3.7**
Ornamentals [12;15;21 ppm]	Adult[2]	0.03	NC	0.04	NC	0.06	NC
	Larval[3]	**2.9**	**1.7**	**3.6**	**2.2**	**5.2**	**3.2**

TG=Tall Grass; **B**=Broadleaf Plants; **A**=Arthropods; **NC**=MATC could not be calculated due to non-definitive LOAEC
[1] Based on a 10-d chronic study for adult honey bees (MRID 51459451). Toxicity endpoints presented in **Table 3-31**.
[2] Based on a 22-d chronic study for larval honey bees (MRID 51459453). Toxicity endpoints presented in **Table 3-31**.

3.6 Aquatic and Terrestrial Plant Risk Assessment

3.6.1 Summary of the Risk Assessment Approach

The Plant Assessment Tool (PAT, version 2.8[24]) was used to estimate environmental exposure to aquatic, wetland, and terrestrial plants. PAT is a mechanistic model that incorporates chemical-specific fate data and transport processes to estimate pesticide concentrations in three modules representing 1) terrestrial dry land, 2) wetland[25], and 3) aquatic plant environments or exposure zones. For each of the wetland and aquatic modules, runoff, erosion, and spray drift are initially modeled using the Pesticide in Water Calculator (PWC), which leverages the Pesticide Root Zone Model and Variable Volume Water Model (PRZM.VVWM). These exposure predictions are imported into PAT and used to estimate exposure based on specific assumptions for the module of interest. PAT uses weather information output from PWC and estimates of spray drift deposition from AgDRIFT to model exposure in the terrestrial module. Each module generates 1-in-10 year estimated environmental concentrations (EECs), which are used to calculate risk quotients (RQs) for multiple terrestrial and aquatic plant toxicity endpoints. This method allows for a process-based assessment of a chemical's potential risk to upland terrestrial, semi-aquatic (wetland), and aquatic plants.

Exposure for aquatic plants in the aquatic plant exposure zone (APEZ) is modeled using PWC and is equivalent to the EPA standard pond EECs. Likewise, the wetland plant exposure zone (WPEZ) is modeled using the PWC, and exposure estimates are processed in PAT to estimate aquatic (mass per volume of water) and terrestrial (mass per area) environmental

[24] https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological
[25] A wetland is a shallow waterbody that may include permanently or intermittently flooded areas. Examples include wet meadows, marshes, swamps, and riparian areas. For this document, EPA is not referring to a wetland as defined under the Clean Water Act.

concentrations. For terrestrial plants, runoff and erosion are modeled using information output from the PRZM module of the PWC and spray drift is modeled using AgDRIFT deposition values. The PAT terrestrial plant exposure zone (TPEZ) module uses a mixing cell approach to represent water within the active root zone area of soil, and it accounts for flow through the TPEZ caused by both treated field runoff and direct precipitation on the TPEZ. Pesticide losses from the TPEZ occur from transport, degradation, or leaching below the active root zone (below 15 cm).

3.6.2 Aquatic Plant Risk Assessment

Assessments for cyclobutrifluram exposure for aquatic plants relies on environmental concentration estimates from the Aquatic Plant Exposure Zone (APEZ) and the Wetland Plant Exposure Zone (WPEZ) in comparison to the aquatic plant toxicity endpoints. The APEZ and WPEZ are intended to represent environments where vascular and non-vascular aquatic plants are exposed to pesticide via runoff, erosion, and spray drift. For the APEZ, EECs represent the 1-in-10 year daily mean. The WPEZ is intended to represent a non-target wetland plant community that can exist in saturated or flooded conditions; this zone is detailed more in the subsequent section. The APEZ and WPEZ risk evaluation considers that the pond or wetland community can be immediately adjacent to the treated field or some undetermined distance away and be exposed via spray drift and/or runoff. RQs for aquatic plants are calculated using APEZ and WPEZ EECs expressed in µg/L and the most sensitive toxicity endpoints for vascular and non-vascular aquatic plants. The highest EECs and RQs for aquatic plants are presented in **Table 3-35** for each proposed use.

All EECs in the APEZ (2.4 - 15 µg/L) and WPEZ (4.5 - 70 µg/L) are at least one magnitude lower than the most sensitive endpoints for aquatic plants (570 - 11,000 µg a.i./L). RQ values for non-listed vascular aquatic plants ranged from <0.01 - 0.01. RQs for non-listed non-vascular plants ranged from <0.01 - 0.01. The RQs for listed species ranged from <0.01 - 0.12 with the higher RQs occuring in the WPEZ. None of the aquatic plant RQs in the APEZ or WPEZ exceed the level of concern (LOC) for plants set at 1.0 for non-listed and listed species. No direct effects to aquatic plants are expected from cyclobutrifluram use.

Table 3-35. Highest EECs and RQs for the Most Sensitive Vascular and Non-Vascular Aquatic Plants in the APEZ and WPEZ (PAT, v. 2.8)

Use Site (Scenario Summary)	Aquatic Plant Exposure Zone (APEZ)[1]					Wetland Plant Exposure Zone (WPEZ)[2]				
	EEC (µg/L)	Vascular Aquatic Plants[3]		Non-Vascular Aquatic Plants[4]		EEC (µg/L)	Vascular Aquatic Plants[3]		Non-Vascular Aquatic Plants[4]	
		Non-Listed RQ	Listed RQ	Non-Listed RQ	Listed RQ		Non-Listed RQ	Listed RQ	Non-Listed RQ	Listed RQ
Proposed Use on Cotton: Seed Treatment at 0.085 lb a.i./A										
Cotton ST (Cotton_V4)	4.2	<0.01	0.01	<0.01	<0.01	9.3	<0.01	0.02	<0.01	<0.01
Proposed Use on Soybean: Seed Treatment at 0.085 lb a.i./A										
Soybean ST (Soybean_V4)	2.4	<0.01	<0.01	<0.01	<0.01	4.5	<0.01	0.01	<0.01	<0.01
Proposed Use on Romaine: 1 application at 0.089 lb a.i./A prior to/at planting										
Romaine soil (Vegetable fresh or processing market_V4)	5.1	<0.01	0.01	<0.01	<0.01	24	<0.01	0.04	<0.01	0.01
Proposed Use on Turf: 2 applications at 0.22 lb a.i./A with application interval of 14 days										
Turf foliar (PAturfSTD APEZ; FLturfSTD WPEZ)	13	<0.01	0.02	<0.01	<0.01	65	0.01	0.11	0.01	0.02
Proposed Use on Ornamentals: 2 applications at 0.187 lb a.i./A with application interval of 14 days										
Ornamental soil (TNnurserySTD APEZ; CAnurserySTD WPEZ)	15	<0.01	0.03	<0.01	<0.01	70	0.01	0.12	0.01	0.02

The LOC is 1.0 for listed and non-listed plants.

[1] The EECs used to calculate the RQs for aquatic plants in the APEZ are based on the highest 1-in-10-year daily average value from **Appendix F** for each use.

[2] The EECs used to calculate the RQs for aquatic plants in the WPEZ are calculated in PAT and are based on the scenario that resulted in the highest wetland EEC in PAT.

[3] MRID 51459446; study conducted with duckweed (*Lemna gibba*), IC_{50} = 11,000 µg a.i./L [non-listed species], NOAEC = 570 µg a.i./L [listed species]

[4] MRID 51459438; study conducted with green algae (*Raphidocelis subcapitata*), IC_{50} = 7000 µg a.i./L [non-listed species], NOAEC = 3600 µg a.i./L [listed species]

3.6.3 Semi-Aquatic Plant Risk Assessment

Assessments for cyclobutrifluram exposure for semi-aquatic plants relies on environmental concentration estimates from the Wetland Plant Exposure Zone (WPEZ) in comparison to terrestrial plant toxicity endpoints. In relation to terrestrial plants, the WPEZ is intended to represent a non-target wetland plant community that is exposed to pesticide via overland flow and spray drift. The WPEZ is defined as a one-hectare (HA) wetland receiving inputs from the adjacent 10 ha field. With the WPEZ, two depth zones are defined: a standing water zone and a saturated soil pore water zone. The maximum depth of standing water is set at 15 cm, but it is allowed to dry down to a minimum depth of 0.5 cm using algorithms from VVWM. The model excludes comparison of standing water depth in less than 0.5 cm. For comparison to terrestrial plant study endpoints, the total mass per area is calculated and expressed on an area-normalized basis (lb a.i./A).

Represented in **Table 3-36**, WPEZ EECs (0.0068 - 0.042 lb a.i./A) are at least 6X lower than the most sensitive endpoints from terrestrial plant studies (0.27 - 0.81 lb a.i./A). RQ values could not be calculated for non-listed terrestrial plants, due to non-definitive endpoints for both seedling emergence and vegetative vigor studies. The RQs for listed species ranged from 0.01 to 0.16 for seedling emergence and 0.01 - 0.05 for vegetative vigor. None of the RQ values representing the risk potential in the WPEZ exceeded the LOC. No direct effects to semi-aquatic plants are expected from cyclobutrifluram use.

Table 3-36. Highest EECs and RQs for the Most Sensitive Semi-Aquatic Plant Taxa (PAT, v. 2.8)

Use Site (Scenario Summary)	Semi-Aquatic Plant EEC (lb a.i./A)	Seedling Emergence[1]				Vegetative Vigor[2]			
		Non-Listed Monocot RQ	Listed Monocot RQ	Non-Listed Dicot RQ	Listed Dicot RQ	Non-Listed Monocot RQ	Listed Monocot RQ	Non-Listed Dicot RQ	Listed Dicot RQ
Proposed Use on Cotton: Seed Treatment at 0.085 lb a.i./A									
Cotton ST (Cotton_V4)	0.013	NC[3]	0.05	NC[3]	0.02	NC[3]	0.02	NC[3]	0.02
Proposed Use on Soybean: Seed Treatment at 0.085 lb a.i./A									
Soybean ST (Soybean_V4)	0.0068	NC[3]	0.03	NC[3]	0.01	NC[3]	0.01	NC[3]	0.01
Proposed Use on Romaine: 1 application at 0.089 lb a.i./A prior to/at planting									
Romaine soil (Vegetable fresh or processing market_V4)	0.018	NC[3]	0.07	NC[3]	0.02	NC[3]	0.02	NC[3]	0.02
Proposed Use on Turf: 2 applications at 0.22 lb a.i./A with application interval of 14 days									
Turf foliar (PAturfSTD APEZ)	0.027	NC[3]	0.10	NC[3]	0.03	NC[3]	0.03	NC[3]	0.03
Proposed Use on Ornamentals: 2 applications at 0.187 lb a.i./A with application interval of 14 days									
Ornamental soil (CAnurserySTD)	0.042	NC[3]	0.16	NC[3]	0.05	NC[3]	0.05	NC[3]	0.05

NC=not calculated due to non-definitive endpoints

The LOC is 1.0 for listed and non-listed plants.

[1] Based on the NOAEC (listed species) and IC_{25} (non-listed species) in the seedling emergence test (MRID 51459460). The most sensitive monocot was ryegrass based on effects to emergence and survival (NOAEC = 0.27 lb a.i./A, IC_{25} > 0.80 lb a.i./A). The most sensitive dicot could not be determined due to lack of significant effects of the treatment (NOAEC = 0.80/0.81 lb a.i./A, EC/IC_{25} > 0.80/>0.81 lb a.i./A).

[2] Based on the NOAEC (listed species) and IC_{25} (non-listed species) in the vegetative vigor test (MRID 51459461). The most sensitive monocot and dicot could not be determined due to lack of significant effects of the treatment (all NOAEC = 0.80 lb a.i./A, all EC/IC_{25} > 0.80 lb a.i./A).

[3]The non-listed RQ is not calculated (NC) because the available regression-based endpoints (IC_{25}/EC_{25}) were non-definitive.

3.6.4 Terrestrial Plant Risk Assessment

The TPEZ is intended to represent a non-target terrestrial (non-inundated) plant community immediately adjacent to a treated field and can be exposed via sheet flow and drift during treatment to the treated field. It is defined as an area adjacent to a treated field with a length of 316 m and width of 30 m. The length is equal to the length of the edge of the treated field and the width represents the distance that overland surface flow can travel before sheet flow transitions to concentrated flow (USDA, 2010). For the TPEZ, a mixing cell approach is used to represent water within the active root zone area of the soil, which accounts for flow through the TPEZ cause by both runoff and direct precipitation.

TPEZ EECs (0.012 - 0.12 lb a.i./A), represented in **Table 3-37**, are about 2X lower than the most sensitive endpoints from terrestrial plant studies (0.27 - 0.81 lb a.i./A). RQ values could not be calculated for non-listed terrestrial plants, due to non-definitive endpoints for both seedling emergence and vegetative vigor studies. The RQs for listed species ranged from 0.01 to 0.43 for seedling emergence and 0.01 - 0.14 for vegetative vigor. None of the RQ values representing the risk potential in the TPEZ exceeded the LOC. Cyclobutrifluram is not expected to cause any direct effects to terrestrial plants from proposed use patterns.

Table 3-37. Highest EECs and RQs for the Most Sensitive Terrestrial Plant Taxa (PAT, v. 2.8)

Use Site (Scenario Summary)	Terrestrial Plant EEC (lb a.i./A)	Seedling Emergence[1]				Vegetative Vigor[2]			
		Non-Listed Monocot RQ	Listed Monocot RQ	Non-Listed Dicot RQ	Listed Dicot RQ	Non-Listed Monocot RQ	Listed Monocot RQ	Non-Listed Dicot RQ	Listed Dicot RQ
Proposed Use on Cotton: Seed Treatment at 0.085 lb a.i./A									
Cotton ST (Cotton_V4)	0.020	NC[3]	0.07	NC[3]	0.02	NC[3]	0.02	NC[3]	0.02
Proposed Use on Soybean: Seed Treatment at 0.085 lb a.i./A									
Soybean ST (Soybean_V4)	0.012	NC[3]	0.04	NC[3]	0.01	NC[3]	0.01	NC[3]	0.01
Proposed Use on Romaine: 1 application at 0.089 lb a.i./A prior to/at planting									
Romaine soil (Vegetable fresh or processing market_V4)	0.038	NC[3]	0.14	NC[3]	0.05	NC[3]	0.05	NC[3]	0.05
Proposed Use on Turf: 2 applications at 0.22 lb a.i./A with application interval of 14 days									
Turf foliar (FLturfSTD)	0.049	NC[3]	0.18	NC[3]	0.06	NC[3]	0.06	NC[3]	0.06
Proposed Use on Ornamentals: 2 applications at 0.187 lb a.i./A with application interval of 14 days									
Ornamental soil (CAnurserySTD)	0.12	NC[3]	0.43	NC[3]	0.14	NC[3]	0.14	NC[3]	0.14

NC=not calculated due to non-definitive endpoints

The LOC is 1.0 for listed and non-listed plants.

[1] Based on the NOAEC (listed species) and IC_{25} (non-listed species) in the seedling emergence test (MRID 51459460). The most sensitive monocot was ryegrass based on effects to emergence and survival (NOAEC = 0.27 lb a.i./A, IC_{25} > 0.80 lb a.i./A). The most sensitive dicot could not be determined due to lack of significant effects of the treatment (all NOAEC = 0.80/0.81 lb a.i./A, all EC/IC_{25} > 0.80/>0.81 lb a.i./A).

[2] Based on the NOAEC (listed species) and IC_{25} (non-listed species) in the vegetative vigor test (MRID 51459461). The most sensitive monocot and dicot could not be determined due to lack of significant effects of the treatment (all NOAEC = 0.80 lb a.i./A, all EC/IC_{25} > 0.80 lb a.i./A).

[3] The non-listed RQ is not calculated (NC) because the available regression-based endpoints (IC_{25}/EC_{25}) were non-definitive.

4 Biological Evaluation with Effects Determinations for ESA-Listed Species and Designated Critical Habitats

4.1 Taxonomic Groups requiring Listed Species Analyses

As a new active ingredient proposed for registration for use to control parasitic nematodes and soil-borne and foliar fungal diseases for romaine, cotton, soybean, turf and ornamentals, the risk assessment for cyclobutrifluram, a nematicide/fungicide, includes evaluation of potential impacts to listed species and designated critical habitats (CHs). As previously stated, the need for listed species analysis is first determined based on the conclusions outlined in the taxon-level assessment. Based on conclusions in the taxon-level assessment, potential risk is for on-field exposures only, and listed species analyses for chronic exposures are needed for seed consuming mammals based on seed treatment uses of cyclobutrifluram for cotton and soybean crops. In addition, based on listed species analyses for potential risk of cyclobutrifluram exposures to listed terrestrial invertebrates, listed species analysis is also needed to assess potential direct effects to listed terrestrial invertebrate larvae based on turf and ornamental uses of cyclobutrifluram. The listed species assessment for direct effects to terrestrial invertebrates focuses on assessing potential for chronic exposure effects to larvae that consume dietary items other than pollen and/or nectar, as risk from pollen and nectar consumption is considered low based on previously discussed pollinator protection language on the label.

Summarized in **Table 4-1**, the current listed species assessment consists of assessing the potential for direct chronic effects to listed seed-consuming mammals and terrestrial invertebrate larvae and their critical habitats (CHs). Additionally, indirect impacts to pollination, prey, habitat, or dispersal (PPHD) of other listed species, caused by direct impacts to these groups, is also included in the listed species analyses. Indirect impacts to terrestrial plants are not included in the species-specific analyses as impacts to PPHD for terrestrial plants are not reasonably certain to occur based on the specifics of the potential risks of concern; risk to terrestrial invertebrate pollinators is low due to bloom restrictions on the label, and no currently listed terrestrial plants obligately rely on seed eating mammals for pollination or dispersal.

Table 4-1. Taxonomic Groups requiring Species-Specific Review for the Listed Species Assessment.

Taxonomic Group	Additional Species-Specific Review Needed?	
	Potential Direct Effects	Potential Indirect Impacts to PPHD (relevant taxonomic group for PPHD)
Fish, Aquatic-Phase Amphibians	No	No
Aquatic Invertebrates	No	No
Mammals	Yes[1]	Yes (terrestrial invertebrates; mammals[1])
Birds, Reptiles, Terrestrial Amphibians	No	Yes (terrestrial invertebrates; mammals[1])
Terrestrial Invertebrates	Yes[2]	Yes (terrestrial invertebrates; mammals[1])
Aquatic and Terrestrial Plants	No	No[3]

[1]This only applies to mammals that consume treated cotton or soybean seeds on the field where these seeds are planted.
[2] This only applies to terrestrial invertebrate larvae of species on treated turf and ornamental areas.
[3] Indirect impacts to listed terrestrial plants are not expected. Effects are not reasonably certain to occur to terrestrial invertebrate pollinators from pollen and nectar consumption due to label bloom restrictions. No currently listed terrestrial plants rely solely on seed-consuming mammals for seed dispersal or pollination. In addition, effects to mammals and invertebrates are limited to the treatment area. Listed plants are not expected to occur on the use sites, with the exception of the spring creek bladderpod. Potential impacts to the spring creek bladderpod are mitigated with the pollinator restriction language included on the proposed labels.

4.2 Determining Action Area and Overlap

After identifying the taxonomic groups requiring listed species analyses, the likelihood of the action area overlapping with the ranges and CHs of these listed species is established. The action area[26] is based on proposed use sites of cyclobutrifluram and potential non-target areas where cyclobutrifluram exposure may occur (e.g., due to spray drift and/or off-site runoff/erosion transport). For cyclobutrifluram, risk beyond the treated area is not expected. EPA determined effects to listed species and their designated CHs are not reasonably certain to occur for romaine use sites in the action area based on the currently proposed application methods and rates; this proposed use site was not assessed further is the current analysis. In this assessment, species-specific analyses for cyclobutrifluram include cotton, soybean, turf, and ornamental use sites (on-field) in the contiguous United States (CONUS), Hawaii, Alaska, and the U.S. territories.

[26] Action area means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. 50 CFR §402.02

EPA relies on the proposed uses of cyclobutrifluram (**Table 2-1**) to identify spatial data that represent potential application sites. These data are referred to as Use Data Layers (UDLs)[27]. The selection of UDLs for cyclobutrifluram in **Table 4-2** represent the potential locations of cyclobutrifluram use, for crops included in the spatial analysis, in the CONUS and the non-lower 48 (NL48; states and U.S. territories outside of the CONUS). It should be noted that several of the UDLs presented in **Table 4-2** may overestimate the specific uses sites proposed for cyclobutrifluram, as some UDLs are composite UDLs and representative of multiple individual use sites, including use sites that are not proposed for cyclobutrifluram use. If necessary in later steps of the effects determination process, use site refinements for these composite UDLs may be utilized to get more precise estimations of use site overlap.

Table 4-2. Use Sites and Comparable Use Data Layers Selected for UDL Overlap Analysis.

Proposed Use for Cyclobutrifluram		CONUS UDL	NL48 UDL	Taxa with Risks of Concern
Cotton		Cotton	All Ag	Mammals
Soybean		Soybean	All Ag	
Turfgrass	Golf courses; sports fields; parks	Open Space Developed	Open Space Developed	Terrestrial Invertebrates
	Institutional, commercial, and residential lawns; municipal grounds	Developed	Developed	
	Sod farms	Other Crops	All Ag	
Ornamentals	Ornamental plants and non-bearing (juvenile) fruit and nut trees, vines, and berries produced and grown in greenhouses and nurseries (including shade houses, lath houses and other outdoor growing structures); evergreen (including conifer) and deciduous tree nurseries and forest nurseries	Nurseries	Nurseries	
	Christmas tree farms	Xmas Trees	Managed Forest	
	Residential and commercial landscapes	Developed	Developed	
	Parks; interior landscapes	Open Space Developed	Open Space Developed	

[27] https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#overlap

4.3 Likelihood of Direct and Indirect Effects

Effects determinations and overlap analysis were completed separately for listed species and CHs. After determining taxa based risk conclusions (**Section 3**) and defining the action area, the species-specific review starts with evaluation of the overlap between listed species and their designated CHs (listed as of December 2023) with the proposed use sites of concern and consideration of whether effects are reasonably certain to occur for determination of a No Effect (NE) or May Affect (MA) classification. Overlap assessment was completed using the Use Data Layer (UDL) Overlap tool version 2[28]. Species considerations for reasonable certainty aimed to make certain the species fits within the taxonomic groups identified as having risk potential in the taxon-level assessment, such as mammals that eat seeds or terrestrial invertebrates that consume dietary items other than pollen and nectar. CH considerations for reasonable certainty aimed to make certain the taxa of concern, mammals and terrestrial invertebrates, are considered a necessary part of the habitat itself through the use of defined physical and biological features (PBFs) of the CH or general habitat information, if specific PBF descriptions were not yet defined. Any listed species or CH where effects were not reasonably certain to occur were designated NE, and remaining species were designated MA and underwent further species-specific review.

For species and CHs designated MA, the next step of the assessment process relied on more refined details about each species and CH to determine if effects were Not Likely to Adversely Affect (NLAA) or Likely to Adversely Affect (LAA). NLAA determinations are made when exposure is discountable or when effects are expected to be insignificant. Discountable exposure means effects are extremely unlikely to occur. Insignificant effects mean it would not be possible to meaningfully measure, detect, or evaluate effects, and effects should never reach the level where take occurs. LAA determinations are made when exposure and effects are likely.

Previous considerations, such as overlap, habitat, and dietary habits, were evaluated on a more granular level, as needed, to assess the likelihood of potential effects. Overlap refinements considered data on average usage of nematicides and fungicides (USDA Census of Agriculture data on pesticide usage [2002-2017]; only applicable to agricultural use sites) and refinements of composite UDLs for more precise overlap percentages for the specific proposed use sites for cyclobutrifluram. For habitat and diet, individual species/CH information was evaluated in a more thorough manner to determine the extent to which potential effects would impact the individual species/CH. Information on obligate relationships to the species of concern, likelihood of foraging on-field, and likelihood of habitat overlapping with the proposed use sites were examples of the refined details used for making NLAA and LAA effects determinations.

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[28] https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#overlap

The following section summarizes the effects determination findings. More detailed information on the species-specific considerations and the decision-making process can be found in **Appendix D**. **Appendix C** contains summary tables of all listed species and CHs with MA effects determinations (NE determinations not included) and whether NLAA determinations were based on discountable exposures or insignificant effects.

4.3.1 Direct Effects

Table 4-3 and **Table 4-4** give a general overview of the process for determining the likelihood of direct effects to species and critical habitat. The general criteria considered for each step in the process are presented within the tables. Subsequent sections provide more detail on the specifics of the criteria used for categorizing each species. **Appendix D** contains the spreadsheets detailing the process for each step and how the factors are considered for each individual listed species and their CHs.

Table 4-3. Likelihood of Direct Effects to Species.

	Likelihood of Direct Effects	
	Not reasonably expected to occur:	**Unlikely to occur:**
Factors Considered	• Taxon-Level Conclusions • Listed RQ/LOC • UDL Overlap < 1% [1] • Marine/Aquatic[2] • Dietary Items[3]	*In addition to factors listed for not reasonably expected to occur:* • Likelihood of On-field Exposure[4] • UDL Refinements[5]
# of Species	175 Fish 195 Aquatic Invertebrates 96 Birds 944 Plants 45 Amphibians 56 Reptiles 94 Mammals 19 Terrestrial Invertebrates	2 Mammals 100 Terrestrial Invertebrates

[1] The overlap percentage is rounded to whole numbers due to the precision of the remotely sensed data. <1% overlap represents an actual overlap of <0.45%; >5% overlap represents an actual overlap of >4.45%. Overlap that is less than 0.45% represents no overlap. This is primarily because this level of overlap is beyond the precision of the overlap data and is not considered true overlap.

[2] Risks of concern are for terrestrial animals on-field. Effects are not reasonably certain to occur for any marine/aquatic species.

[3] This factor includes consideration of listed species diet to determine if mammals are seed consumers or if terrestrial invertebrates only consume pollen and/or nectar (listed bees). Pollinator protection language on the proposed label for turf and ornamentals restricts applications near blooming/flowering weeds/plants and drift to flowering plants.

[4] Habitat descriptions for individual listed species are used to determine the likelihood that a species would occur on a proposed use site. For terrestrial invertebrate larvae, the need for larval host plants in off-field habitats is also considered.

[5] When necessary, refinements to the overlap percentage are completed to account for overestimation by composite UDLs. For example, the NL48 Managed Forests UDL accounts for several individual use sites, but

cyclobutrifluram is only proposed for use on one of the use sites within that specific UDL, Christmas tree farms. Data on what percentage of the UDL actually pertains to Christmas tree farms is used to obtain a more precise estimate of overlap with Christmas tree farms in the NL48.

Table 4-4. Likelihood of Direct Effects to Critical Habitat.

	Likelihood of Direct Effects	
	Not reasonably expected to occur:	**Unlikely to occur:**
Factors Considered	• Taxon-Level Conclusions • Listed RQ/LOC • Physical and Biological Features of CH • UDL Overlap < 1%[1] • Marine/Aquatic[2]	*In addition to factors listed for reasonably expected to occur:* • On-field Likelihood[3] • UDL Refinements[4]
# of CHs	122 Fish 109 Aquatic Invertebrates 35 Birds 505 Plants 29 Amphibians 28 Reptiles 47 Mammals 6 Terrestrial Invertebrates	4 Mammals 59 Terrestrial Invertebrates

[1] The overlap percentage is rounded to whole numbers due to the precision of the remotely sensed data. <1% overlap represents an actual overlap of <0.45%; >5% overlap represents an actual overlap of >4.45%. Overlap that is less than 0.45% represents no overlap. This is primarily because this level of overlap is beyond the precision of the overlap data and is not considered true overlap.
[2] Risks of concern are for terrestrial animals on-field. Effects are not reasonably certain to occur for any marine/aquatic species.
[3] Habitat descriptions are used to determine the likelihood that a critical habitat would coincide with a proposed use site.
[4] When necessary, refinements to the overlap percentage are completed to account for overestimation by composite UDLs. For example, the NL48 Managed Forests UDL accounts for several individual use sites, but cyclobutrifluram is only proposed for use on one of the use sites within that specific UDL, Christmas tree farms. Data on what percentage of the UDL actually pertains to Christmas tree farms is used to obtain a more precise estimate of overlap with Christmas tree farms in the NL48.

As stated in **Section 4.1**, direct effects are not reasonably expected to occur for aquatic vertebrates, aquatic invertebrates, birds, plants, amphibians, reptiles, mammals that do not consume seeds, and terrestrial invertebrates that solely consume pollen and/or nectar. For all listed species in these taxonomic groups or in the specified subsets of mammals and terrestrial invertebrates, it was determined that direct effects were not reasonably certain to occur. Additionally, direct effects were also not reasonably certain to occur for any listed marine mammal, as potential effects are limited to those species that occur directly on treated areas, all of which are considered terrestrial. One of the most impactful considerations for direct effects relies on the UDL overlap results. Direct effects are not reasonably certain to occur for any listed seed-eating mammal or terrestrial invertebrate whose range and CH are found to overlap with less than 1% of the selected UDLs, representative of proposed use sites. In addition to the previously mentioned groups, direct effects are not reasonably certain to occur for 94 listed mammals, 19 listed terrestrial invertebrates, 47 mammalian CHs, and 6 terrestrial invertebrate CHs. For any species or CH for which it was not determined that direct effects were not reasonably certain to occur, based on the criteria mentioned above, the next step was to determine the likelihood the species or CH will be directly affected.

For direct effects to listed species, 2 out of 96 mammals and 100 out of 119 terrestrial invertebrates need additional evaluation to determine the likelihood of direct effects. For mammals, the likelihood for seed eating mammals to be exposed to treated seeds on cotton or soybean fields is evaluated based on habitat descriptions and dietary habits. The two mammalian listed species identified as needing additional evaluation, Amargosa Vole (*Microtus californicus scirpensis*) and Texas Kangaroo Rat (TKR; *Dipodomys elator*), primarily eat seeds. The Amargosa Vole occurs in isolated herbaceous wetland habitats, making it unlikely to occur on field. For the TKR, the recent Biological Opinion (BiOp) for methomyl states, it is not anticipated that "individuals are likely to occur on agricultural use sites as cultivated agricultural areas do not likely provide the necessary habitat features to support individuals" (USFWS, 2024). Based on these additional considerations, direct adverse effects to these two mammalian species are considered unlikely, because exposure is discountable. For terrestrial invertebrates, the likelihood for listed species larvae to be exposed on-field following cyclobutrifluram applications to turf or ornamentals is evaluated based on habitat descriptions, need for larval host plants, and potential for larval host plants to be on-field. Based on these criteria, for all listed terrestrial invertebrate species requiring additional evaluation to assess likelihood of direct adverse effects, it is determined direct adverse effects are unlikely, because the species are unlikely to be on the treated areas and exposure is considered discountable. For some species in the NL48, the UDL with significant overlap is the NL48 Managed Forests UDL and the habitat details for the species consisted of non-specific general forest descriptions. The NL48 Managed Forests UDL is a composite of several types of forest use sites, but cyclobutrifluram is proposed for use for only one of the use sites within that composite UDL, Christmas tree farms. As detailed in the final biological evaluation for sulfoxaflor (USEPA, 2023), Christmas trees make up <1% of NL48 Managed Forests UDL in Hawaii. This data is used for spatial refinements to the original UDL overlap percentages for the composite NL48 Managed Forests UDL. For all listed species where this refinement is considered, overlap between the species range and Christmas tree use sites is determined to be <1%.

For designated CHs, EPA concluded that direct effects for 47 out of 51 mammalian CHs and 6 out of 65 terrestrial invertebrate CHs were not reasonably certain to occur, based on species-specific overlap and any defined FWS physical and biological features (PBFs). For CHs that do not contain specific GIS files, the overlap for the species range is used as a substitute. For the remaining species, additional considerations needed to be made to evaluate the likelihood of the CH being directly affected by cyclobutrifluram. Similar to the additional considerations for the species, general habitat and diet requirements in those habitats are considered. Based on CH-specific information, direct effects are unlikely for the remaining CHs, because either the mammals (2) and terrestrial invertebrates (59) are unlikely to occur on use sites and therefore exposure is discountable, or effects are considered insignificant, because potentially affected dietary items of mammals (seeds) are not a primary food source (2). For CHs of terrestrial invertebrates, refinements for the NL48 Managed Forests UDL, as described for direct effects to species, are also used for spatial refinements for habitats described as non-specific general forest habitats, when necessary.

4.3.2 Indirect Effects

Table 4-5 and **Table 4-6** give a general overview of the process for determining the likelihood of indirect impacts to listed species based on direct effects to listed mammals and listed terrestrial invertebrates. The general criteria for each step are highlighted in the second row of each table. **Appendix D** contains links to the spreadsheets detailing the process for each step and how the factors are considered for each listed species and impacts to their PPHD.

As stated in **Section 4.1**, indirect effects are not reasonably expected to occur for aquatic vertebrates, aquatic invertebrates, or plants. This assessment evaluates indirect impacts to the PPHD of amphibians, birds, mammals, reptiles, and terrestrial invertebrates. Indirect effects are also not reasonably certain to occur for any listed marine mammal, aquatic reptile, sea turtle, or pond turtle as potential effects are limited to those species that occur directly on treated areas. Considerations were similar to those for direct effects but focus more on how the PPHD of each listed species could be impacted by potential population-level declines in mammalian and terrestrial invertebrate species. For determining the likelihood of indirect effects based on direct effects to mammals, factors are considered to determine if listed species rely on seed consuming mammals and to what extent. For determining the likelihood of indirect effects based on effects to terrestrial invertebrates, factors are considered to determine if listed species rely on adult and larval terrestrial invertebrates not just larvae, as is done in the direct effects determinations; effects to larvae would ultimately results in declines of adult populations of terrestrial invertebrates. Indirect impacts were assessed for listed species and for designated CHs. For assessment of designated CHs, defined PBFs were used in a similar manner to the assessment for direct effects.

For indirect impacts to species from direct effects to mammals, indirect impacts are not reasonably expected to occur for 91 out of 96 birds, 44 out of 45 amphibians, 52 out of 56 reptiles, 90 out of 96 mammals, and 118 out of 119 terrestrial invertebrates (**Table 4-5**). Additional evaluation to determine the likelihood of indirect impacts is needed for 5 birds, 1 amphibian, 4 reptiles, 6 mammals, and 1 terrestrial invertebrate. Based on additional analysis of habitats and relationships to mammals, it is determined that indirect impacts based on direct effects to mammals are unlikely for these 17 listed species. Indirect effects are considered insignificant for these 17 species, because effects to PPHD that relies on mammals are not expected.

For indirect impacts to CHs from direct effects to mammals, indirect impacts are not reasonably expected to occur for 33 out of 35 bird CHs, 28 out of 29 amphibian CHs, 28 out of 28 reptile CHs, 45 out of 51 mammal CHs, and 64 out of 65 terrestrial invertebrate CHs (**Table 4-5**). Additional evaluation to determine the likelihood of indirect impacts is needed for 2 bird CHs, 1 amphibian CH, 6 mammal CHs, and 1 terrestrial invertebrate CH. Based on additional analysis of habitat descriptions and importance of mammals to the success of the CHs, it is determined that indirect impacts based on direct effects to mammals are unlikely for these 10 CHs. Indirect effects are considered insignificant for these 10 CHs, because effects to PPHD that relies on mammals are not expected.

Table 4-5. Likelihood of Indirect Impacts to PPHD based on Direct Effects to Mammals.

	Likelihood of Indirect Effects based on Effects to Mammals	
	Not reasonably expected to occur:	**Unlikely to occur:**
Factors Considered	• Taxon-Level Conclusions • Listed RQ/LOC • Physical and Biological Features of CH • UDL Overlap <1%[1] • Marine/Aquatic?[2] • Relies on Mammals?	*In addition to factors listed for reasonably expected to occur:* • Significance of Mammals in PPHD[3] • Habitats[4]
# of Species	175 Fish 195 Aquatic Invertebrates 91 Birds 944 Plants 44 Amphibians 52 Reptiles 90 Mammals 118 Terrestrial Invertebrates	5 Birds 1 Amphibian 4 Reptiles 6 Mammals 1 Terrestrial Invertebrate
# of CHs	122 Fish 109 Aquatic Invertebrates 33 Birds 505 Plants 28 Amphibians 28 Reptiles 45 Mammals 64 Terrestrial Invertebrates	2 Birds 1 Amphibian 6 Mammals 1 Terrestrial Invertebrate

[1] The overlap percentage is rounded to whole numbers due to the precision of the remotely sensed data. <1% overlap represents an actual overlap of <0.45%; >5% overlap represents an actual overlap of >4.45%. Overlap that is less than 0.45% represents no overlap. This is primarily because this level of overlap is beyond the precision of the overlap data and is not considered true overlap.
[2] Risks of concern are for terrestrial animals on-field. All marine/aquatic animals are determined to be NE.
[3] This factor considers whether or not mammals are the primary avenue for PPHD success for an individual listed species.
[4] Habitat descriptions for individual listed species are used to determine the likelihood that a species would occur on a proposed use site.

For indirect impacts to species from direct effects to terrestrial invertebrates, indirect impacts are not reasonably expected to occur for 43 out of 96 birds, 15 out of 45 amphibians, 43 out of 56 reptiles, 56 out of 96 mammals, and 89 out of 119 terrestrial invertebrates (**Table 4-6**). Additional evaluation to determine the likelihood of indirect impacts is needed for 53 birds, 30 amphibians, 13 reptiles, 40 mammals, and 30 terrestrial invertebrate. Based on additional analysis of habitats and relationships to terrestrial invertebrates, it is determined that indirect impacts based on effects to terrestrial invertebrates are unlikely for these 166 listed species.

Indirect effects are considered insignificant for these 166 species, because effects to PPHD that relies on terrestrial invertebrates are not expected (103) or the species is considered off-field (63).

For indirect impacts to CHs from direct effects to terrestrial invertebrates, indirect impacts are not reasonably expected to occur for 25 out of 35 bird CHs, 23 out of 29 amphibian CHs, 22 out of 28 reptile CHs, 38 out of 51 mammal CHs, and 41 out of 65 terrestrial invertebrate CHs (**Table 4-6**). Additional evaluation to determine the likelihood of indirect impacts is needed for 10 bird CHs, 6 amphibian CHs, 6 reptile CHs, 13 mammal CHs, and 24 terrestrial invertebrate CH. Based on additional analysis of habitat descriptions and importance of terrestrial invertebrates to the success of the CHs, it is determined that indirect impacts based on direct effects to terrestrial invertebrates are unlikely for these 59 CHs. Indirect effects are considered insignificant for these 59 CHs, because effects to PPHD that relies on terrestrial invertebrates are not expected (41) or overlap is <1% with CoA nematicide and fungicide usage data (2) or the CH is considered off-field (16).

Table 4-6. Likelihood of Indirect Impacts to PPHD based on Direct Effects to Terrestrial Invertebrates.

	Likelihood of Indirect Effects based on Effects to Terrestrial Invertebrates	
	Not reasonably expected to occur:	**Unlikely to occur:**
Factors Considered	• Taxon-Level Conclusions • Listed RQ/LOC • Physical and Biological Features of CH • UDL Overlap < 1%[1] • Marine/Aquatic?[2] • Relies on Terrestrial Invertebrates?	*In addition to factors listed for reasonably expected to occur:* • Significance of Terrestrial Invertebrates in PPHD[3] • Habitats[4]
# of Species	175 Fish 195 Aquatic Invertebrates 43 Birds 944 Plants 15 Amphibians 43 Reptiles 56 Mammals 89 Terrestrial Invertebrates	53 Birds 30 Amphibians 13 Reptiles 40 Mammals 30 Terrestrial Invertebrates
# of CHs	122 Fish 109 Aquatic Invertebrates 25 Birds 505 Plants 23 Amphibians 22 Reptiles 38 Mammals 41 Terrestrial Invertebrates	10 Birds 6 Amphibians 6 Reptiles 13 Mammals 24 Terrestrial Invertebrates

[1] The overlap percentage is rounded to whole numbers due to the precision of the remotely sensed data. <1% overlap represents an actual overlap of <0.45%; >5% overlap represents an actual overlap of >4.45%. Overlap that

is less than 0.45% represents no overlap. This is primarily because this level of overlap is beyond the precision of the overlap data and is not considered true overlap.
[2] Risks of concern are for terrestrial animals on-field. All marine/aquatic animals are determined to be NE.
[3] This factor considers whether or not terrestrial invertebrates were the primary avenue for PPHD success for an individual listed species.
[4] Habitat descriptions for individual listed species are used to determine the likelihood that a species would occur on a proposed use site.

4.4 ESA Effects Determinations

For the effects determination process, the likelihood of effects to listed species are analyzed through multiple avenues. EPA analyzes the potential for direct effects to the species and their CHs and the potential for indirect impacts to PPHD of listed species and CHs based on direct effects to seed-consuming mammals and terrestrial invertebrates. All of these factors are considered together to ascertain the overall effects determination reached for each individual listed species and designated CH. **Table 4-7** below summarizes the overall number of individual species and CHs in each effects determination category. **Appendix C Table 1** and **Appendix C Table 2** contain summaries of all listed species and designated CHs, respectively, categorized as May Affect (MA).

Table 4-7. Cyclobutrifluram ESA Effect Determinations.[1]

Effects Determination	Rationale	# of Listed Species	# of CHs
NE	• **Overlap of range/CH and action area is <1%** • **Direct effects and indirect effects due to impacts on PPHD are not reasonably certain to occur. Includes species that are not any of the following:** ○ Listed terrestrial mammals that eat seeds on-field for cotton or soybean use sites and dependent species/CHs ○ Listed terrestrial invertebrates that consume plants or other terrestrial invertebrate prey on-field for turf or ornamentals use sites and dependent species/CHs	• 175 Fish • 195 Aquatic Invertebrates • 944 Plants • 51 Mammals • 42 Birds • 41 Reptiles • 15 Amphibians • 19 Terrestrial Invertebrates	• 122 Fish • 109 Aquatic Invertebrates • 25 Birds • 505 Plants • 22 Amphibians • 22 Reptiles • 36 Mammals • 6 Terrestrial Invertebrates

Effects Determination	Rationale	# of Listed Species	# of CHs
MA/NLAA (Discountable)	• Species/CH not expected to coincide with proposed use sites based on habitat description (applies to direct effects) • Necessary host plants not expected to occur on-field for terrestrial invertebrate larvae	• 2 Mammals • 70 Terrestrial Invertebrates	• 35 Terrestrial Invertebrates
MA/NLAA (Insignificant)	• Seeds not primary food source in CH for mammals • CoA usage overlap <1% (for indirect effects) • Species/CH not expected to coincide with proposed use sites based on habitat description (for indirect effects) • Indirect effects to PPHD not expected	• 43 Mammals • 54 Birds • 15 Reptiles • 30 Amphibians • 30 Terrestrial Invertebrate	• 10 Birds • 7 Amphibians • 6 Reptiles • 15 Mammals • 24 Terrestrial Invertebrates

NE=No Effect; **MA=**May Affect; **NLAA=**Not Likely to Adversely Affect

[1] Based on statements in the proposed labels, the applicant is considering not registering proposed uses of cyclobutrifluram in California (all uses) and New York (cotton statewide; turf and ornamentals in specific counties); however, those statements are not currently a requirement on the proposed labels. If labels are amended to make these statements a requirement, any species or critical habitats located only within the excluded areas with May Affect determinations would be categorized as No Effect, as they would be outside of the action area.

5 Conclusions

5.1 Taxon-Level

Given the proposed uses of cyclobutrifluram and cyclobutrifluram's environmental fate properties, there is a likelihood of exposure of cyclobutrifluram to non-target terrestrial and/or aquatic organisms. The risk of chronic exposure is increased by persistence of parent shown in laboratory studies and by carry over of residues from year to year in field dissipation studies. When used in accordance with the label, such exposure may result in adverse effects upon the survival, growth, and reproduction of non-target terrestrial and aquatic organisms. Based on findings in submitted toxicity studies, there is a potential for direct adverse effects to non-target non-listed and listed mammals from chronic exposure to cyclobutrifluram as a result of proposed seed treatment uses. There is also potential dietary risk to non-listed and listed terrestrial invertebrates if exposed to cyclobutrifluram at application rates proposed for turfgrass or ornamentals (listed species only) on the product label. Potential risk to honey bees (and non-listed terrestrial invertebrates) is not expected to be of concern, as label language restricting application of the product when flowering plants are present minimizes the potential for honey bee dietary exposures to cyclobutrifluram.

5.2 Listed Species and Designated Critical Habitats

Based on risks identified in the taxon-level assessment, overlap of listed species and designated critical habitats with proposed use sites of concern, and species-specific dietary and habitat details, EPA made No Effect (NE) determinations for 1482 (out 1726) listed species and 847 (out of 944) CHs and May Affect, but Not Likely to Adversely Affect (MA/NLAA) determinations for all of the remaining 244 species (72 discountable exposure; 172 insignificant effects) and 97 CHs (35 discountable exposure; 62 insignificant effects).

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850.1010 Acute toxicity freshwater invertebrates (*Daphnia* sp.)

MRID	Citation Reference
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MRID	Citation Reference
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850.1035 Mysid acute toxicity

MRID	Citation Reference
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MRID	Citation Reference
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850.1300 Aquatic invertebrate life cycle (freshwater, *Daphnia* sp.)

MRID	Citation Reference
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850.1350 Aquatic invertebrate life cycle (saltwater, Mysids)

MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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835.2120 Hydrolysis

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835.2240 Photodegradation in Water

MRID	Citation Reference
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MRID	Citation Reference
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MRID	Citation Reference
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835.4200 Anaerobic Soil Metabolism

MRID	Citation Reference
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835.4300 Aerobic Aquatic Metabolism

MRID	Citation Reference
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835.4400 Anaerobic Aquatic Metabolism

MRID	Citation Reference
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MRID	Citation Reference
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51459321 Dunning, J. (2020) Cyclobutrifluram: SYN549522 - Analytical Method ECO_084_01B and Validation for the Determination of Active Substance in Aqueous Spray Solutions: Final Report. Project Number: ENV/19/209, TK0464586. Unpublished study prepared by AgroChemex Limited. 28p.

51459322 Hewa, K. (2020) Cyclobutrifluram: Method Validation - Syngenta Method: Draft Analytical Method GRM076.04A for the Determination of SYN549522 in Water: Final Report. Project Number: PASC/REP/3452, 141/6426, TK0286587. Unpublished study prepared by Primera Analytical Solutions Corporation. 58p.

51459323 Schreitmuller, J. (2020) SYN510275 (Metabolite of Cyclobutrifluram): SYN510275 - Validation of the Analytical Method ECO_084_01G for the Determination of SYN510275 in Aquatic Ecotoxicology Test Media: Final Report. Project Number: 20200364, TK0589090. Unpublished study prepared by Innovative Environmental Services (IES) Limited. 49p.

51459325 Jutson, J. (2021) Cyclobutrifluram: Independent Laboratory Validation - SYN549522 - Analytical Method GRM076.04A for the Determination of SYN549522 in Water: Final Report. Project Number: 1781/7389, TK0592066. Unpublished study prepared by Smithers Viscient Laboratories. 140p.

51459326 DeVellis, S. (2020) Cyclobutrifluram: SYN549522 - Validation of the Analytical Method, ECO_084_02A, for the Determination of the Test Substance in Sediment: Final Report. Project Number: ECO/084/02A, 1781/7280, TK0362715. Unpublished study prepared by Smithers Viscient Laboratories. 78p.

51459328 Holle, J. (2019) Cyclobutrifluram: SYN549522 Analytical Method (ECO_084_03A) and Validation for the Determination of SYN549522 in Larval Diet and Sucrose Feeding Solutions from Honey Bee Ecotoxicology Studies: Final Report. Project Number: S18/02481, TK0362727. Unpublished study prepared by Eurofins Agroscience Services EcoChem GmbH. 55p.

51459329	Lockard, L.; Martin, K.; Bodle, E. (2016) Cyclobutrifluram: SYN549522 Analytical Method Verification for the Determination of the Test Substance in Avian Diet: Final Report. Project Number: 528C/211, TK0270537. Unpublished study prepared by EAG Laboratories. 56p.

860.1380 STOR

MRID	Citation Reference
51460214	Moate, T. (2021) Cyclobutrifluram: Frozen Storage Stability of SYN549522 and its Degradation Products in Turfgrass Clippings, Thatch-Sod, and Soil Matrices from a Georgia, Washington, and Canada Terrestrial Field Dissipation Study: Final Report. Project Number: 180796, TK0427939. Unpublished study prepared by Golden Pacific Laboratories, LLC (GPL). 602p.

FTR

MRID	Citation Reference
51459450	Banman, C. (2019) Cyclobutrifluram: SYN549522 SC (A22011B) Determination of Residues in Cucumber Pollen and Nectar Following Soil Application: Final Report. Project Number: TK0365864, 069SRUS18R0189. Unpublished study prepared by SynTech Research Laboratory Services, LLC. 175p.

Non-Guideline

MRID	Citation Reference
51460203	Boultwood, T.; Garrod, M. (2020) Cyclobutrifluram SYN549522 - Rate of Degradation of (Pyridinyl-2-14C)- SYN549522 on Intact Soil Cores: Final Report. Project Number: PM/16/018, TK0288847. Unpublished study prepared by Syngenta Limited. 92p.
51460221	Garrod, M.; Peranginangin, N. (2021) Cyclobutrifluram (SYN549522): Document M-II, Section 5: Fate and Behavior in the Environment. Project Number: M/II. Unpublished study prepared by Syngenta Crop Protection, LLC. 493p.

Appendix A. Cyclobutrifluram: Summary of Ecological Effect and Environmental Fate Studies Received in Support of the FIFRA Section 3 New Chemical Registration.

The tables included in this Appendix summarize the environmental fate and ecological effect studies used in support of the registration of the proposed terrestrial outdoor uses for cyclobutrifluram. These studies are determined based on the proposed use patterns and the environmental fate and ecological effect data for a pesticide. The tables below summarize the terrestrial and aquatic non-target organism (**Appendix A Table 1**), non-target plant protection (**Appendix A Table 2**), and environmental fate (**Appendix A Table 3**) studies considered in support of the Ecological Risk Assessment (ERA).

Appendix A Table 1. Cyclobutrifluram Terrestrial and Aquatic Non-target Organism Data to Support Section 3 New Active Ingredients

Guideline Number - Study Type		Required	Data Requirement Status	MRID	DER Classification	Comments
Birds (surrogates for terrestrial amphibians and reptiles)						
850.2100 - Avian Acute Oral Toxicity Test	Passerine	Yes	**Complete**	51459415	Acceptable	NA
	Upland Game or Waterfowl	Yes	**Complete**	51459413 51459414	Acceptable	
850.2200 - Avian Sub-acute Dietary Toxicity Test	Waterfowl	Yes	**Complete**	51459421	Acceptable	NA
	Upland Game Bird	Yes	**Complete**	51459422	Acceptable	
850.2300 - Avian Reproduction Test	Waterfowl	Yes	**Complete**	51459420	Acceptable	NA
	Upland Game Bird	Yes	**Complete**	51459419	Acceptable	
Mammals						
850.2400 - Wild Mammal Toxicity Testing		No[1]	**Not Triggered**	NA	NA	NA
850.2500 - Field Testing for Terrestrial Wildlife		No[1]	**Not Triggered**	NA	NA	NA
Aquatic Invertebrates Acute Toxicity (Water-Column Exposure)						
850.1010 - Aquatic Invertebrate Acute Toxicity Test, Freshwater Daphnids		Yes	**Complete**	51459432	Acceptable	NA
850.1025 - Oyster Acute Toxicity Test (Shell Deposition)		Yes	**Complete**	51459434	Supplemental	Mean-measured concentration <80% of nominal in the two lowest test concentrations.
850.1035 - Mysid Acute Toxicity Test		Yes	**Complete**	51459469	Acceptable	NA

Guideline Number - Study Type		Required	Data Requirement Status	MRID	DER Classification	Comments
850.1045 - Penaeid Acute Toxicity Test		No[1]	**Not Triggered**	NA	NA	NA
850.1055 - Bivalve Acute Toxicity Test (Embryo-Larval)		No[1]	**Not Triggered**	NA	NA	NA
Fish Acute Toxicity (surrogates for aquatic-phase amphibians)						
850.1075 - Freshwater Fish Acute Toxicity Test	Coldwater species	Yes	**Complete**	51459423	Acceptable	NA
	Warmwater species	Yes	**Complete**	51459425 51459427	Acceptable	
850.1075 - Saltwater Fish Acute Toxicity Test		Yes	**Complete**	51459426	Acceptable	NA
Aquatic Invertebrate Chronic Toxicity						
850.1300 - Daphnid Chronic Toxicity Test		Yes	**Complete**	51459436	Acceptable	NA
850.1350 - Mysid Chronic Toxicity Test		Yes	**Complete**	51459435	Supplemental	NA
Fish Chronic Toxicity						
850.1400 - Freshwater Fish Early Life Stage (ELS) Toxicity Test		Yes	**Complete**	51459429	Acceptable	NA
850.1400 - Estuarine/ Marine Fish Early Life Stage (ELS) Toxicity Test		Yes	**Complete**	51459428	Supplemental	NA
850.1500 - Fish Life Cycle Toxicity Test	Freshwater	No[1]	**Not Triggered**	NA	NA	NA
	Estuarine/Marine	No[1]	**Not Triggered**	NA	NA	
Bioconcentration Factor (BCF) Study						
850.1710 - Oyster Bioconcentration Factor (BCF)		No[1]	**Not Triggered**	NA	NA	NA
850.1730 - Fish Bioconcentration Factor (BCF)		Yes	**Complete**	51459430	Supplemental	NA
Aquatic Invertebrates Acute Toxicity (Benthic Exposure)						
850.1735 - Spiked Whole Sediment 10-Day Toxicity Test, Freshwater Invertebrates	Midge	Yes	**Complete**	51459444	Acceptable	NA
	Freshwater Amphipod	Yes	**Complete**	51459443	Acceptable	
850.1740 - Spiked Whole Sediment 10-Day Toxicity Test, Saltwater Invertebrates		Yes	**Complete**	51459445	Acceptable	NA
Non-guideline - Whole sediment: chronic (28-65-Day life cycle) Toxicity Test	Freshwater midge	Yes	**Waived**	NA	NA	Studies waived as submitted subchronic sediment studies fulfill data requirement for chronic sediment studies (USEPA 2025, TG646036).
	Freshwater amphipod	Yes	**Waived**	NA	NA	
	Estuarine/Marine amphipod	Yes	**Waived**	NA	NA	

Guideline Number - Study Type	Required	Data Requirement Status	MRID	DER Classification	Comments
Other Aquatic Studies					
850.1850 - Aquatic food chain transfer	No[1]	**Not Triggered**	NA	NA	NA
850.1950 - Field testing for aquatic organisms	No[1]	**Not Triggered**	NA	NA	NA
Terrestrial Invertebrate Toxicity (Surrogate for both *Apis* and non-*Apis* bees)					
850.3020 (OECD Test Guideline 214)- Honey Bee [Adult] Acute Contact Toxicity Test	Yes	**Complete**	51459447	Supplemental	Random assignment to test chambers and bee age not documented.
OECD Test Guideline 213 - Honey Bee Adult Acute Oral (AAO) Toxicity Test	Yes[2]	**Complete**			
OECD Test Guideline 237 - Larval Honey Bee Acute Oral (LAO) (single dose) Toxicity Test	Yes[2]	**Complete**	51459452	Supplemental	Individual bee data, random assignment to test groups, and range-finding test not reported.
OECD Guidance Document 239 - Larval Honey Bee Chronic Oral (LCO) (repeat dose) Toxicity Test	Yes[2]	**Complete**	51459453	Supplemental	Random assignment to test groups not reported. Food consumption significantly reduced by solvent/thickening agent control.
OECD Test Guideline 245 - Honey Bee Adult Chronic Oral (ACO) (repeat dose) Toxicity Test	Yes[2]	**Complete**	51459451	Supplemental	Individual bee data, random assignment to test groups, and range-finding test not reported.
850.3030 - Honey Bee Toxicity of Residues on Foliage	No[1]	**Not Triggered**	NA	NA	NA
OECD Guidance Document 75- Honey Bee Colony Brood Test (Enclosure Study) Under Semi-field Conditions	No[1,2]	**Not Triggered**	NA	NA	NA
Non-guideline Field Trial of Residues in Pollen/Nectar	No[1,2]	**Not Triggered**	51459450	Supplemental	
Non-guideline Semi-field Colony Feeding Study (Oomen *et al*. 1992)	No[1,2]	**Not Triggered**	NA	NA	NA
850.3040 - Field Testing for Pollinators	No	**Not Triggered**	NA	NA	NA

NA =not applicable

1 Per 40 CFR Part 158, specified conditions to require the study are not met.

2 See EFED guidance on exposure and effects testing for assessing risk to bees. (https://www.epa.gov/sites/default/files/2016-07/documents/guidance-exposure-effects-testing-assessing-risks-bees.pdf)

Appendix A Table 2. Cyclobutrifluram Non-target Plant Protection Data to Support Section 3 New Active Ingredients

Guideline Number - Study Type		Required	Data Requirement Status	MRID	DER Classification	Comments
Terrestrial and Wetland Plant Toxicity						
850.4100 - Seedling Emergence and Seedling Growth	Tier 1	Yes	**Complete**	51459460	Acceptable	NA
	Tier 2	Yes	**Complete**	51459460	Acceptable	
850.4150 - Vegetative Vigor	Tier 1	Yes	**Complete**	51459461	Acceptable	NA
	Tier 2	Yes	**Complete**	51459461	Acceptable	
850.4230 – Early Seedling Growth Toxicity Test		No[1]	**Not Triggered**	NA	NA	NA
850.4300 - Terrestrial Plants Field Study		No[1]	**Not Triggered**	NA	NA	NA
Aquatic Plant and Algae Toxicity						
850.4025 - Target Area Phytotoxicity		No[1]	**Not Triggered**	NA	NA	NA
850.4400 - Aquatic Plant Toxicity Test Using *Lemna spp.*	Tier 1	Yes	**Complete**	51459446	Acceptable	
	Tier 2	Yes	**Complete**	51459446	Acceptable	
850.4450 - Aquatic Plants Field Study		No[1]	**Not Triggered**	NA	NA	NA
850.4500 - Algal Toxicity Test		Yes	**Complete**	51459438 51459439 51459441	Acceptable	NA
				51459442	Supplemental	Qualitative use only Non-definitive NOAEC and IC_{50}
850.4550 - Cyanobacteria (*Anabaena flos-aquae*) Toxicity Test		Yes	**Complete**	51459440	Acceptable	NA

NA =not applicable

[1] Per 40 CFR Part 158, specified conditions to require the study are not met.

Appendix A Table 3. Cyclobutrifluram Environmental Fate Test Data to Support Section 3 New Active Ingredients

Guideline Number & Study Type		Required	Data Requirement Status	MRID	DER Classification	Comments
835.2120 - Hydrolysis		Yes	**Complete**	51460222	Acceptable	NA
835.2240 - Photodegradation in Water		Yes	**Complete**	51460223	Supplemental	NA
850.2410 - Photodegradation in Soil		Yes	**Complete**	51460205	Supplemental	NA
835.2370 - Photodegradation in Air		No[1]	**Not Triggered**	NA	NA	NA
835.4100 - Aerobic Soil[2, 4]		Yes	**Complete**	51460201 51460202	Supplemental	NA
835.4200 - Anaerobic Soil		Yes	**Complete**	51460204	Supplemental	NA
835.4300 - Aerobic Aquatic		Yes	**Complete**	51460220	Supplemental	NA
835.4400 - Anaerobic Aquatic		Yes	**Complete**	51460219	Acceptable	NA
835.1230 - Batch Equilibrium		Yes	**Complete**	51460215 51460216 51460224	Acceptable Supplemental Supplemental	NA
835.1240 - Column Leaching		No[1]	**Not Triggered**	NA	NA	NA
835.1410 - Volatility Laboratory		No[1]	**Not Triggered**	NA	NA	NA
835.8100 - Volatility Field		No[1]	**Not Triggered**	NA	NA	NA
835.6100 - Terrestrial Field Dissipation		Yes	**Complete**	51460208 51460209 51460210 51460211 51460212 51460213	Acceptable Acceptable Acceptable Acceptable Acceptable Acceptable	NA
835.6200 - Aquatic Field Dissipation		No[1]	**Not Triggered**	NA	NA	NA
835.6300 - Forestry Dissipation		No[1]	**Not Triggered**	NA	NA	NA
835.7100 – Prospective Groundwater Monitoring		No[1]	**Not Triggered**	NA	NA	NA
850.6100 – Environmental Chemistry Method/ Independent Laboratory Validation	Soil (supports 835.6100 and monitoring)	Yes	**Complete**	51459316 51459318 51459317	Acceptable	NA
	Water (supports monitoring)	Yes	**Complete**	51459319, 51459325	Acceptable	NA
	Sediment (supports monitoring)	No[1]	**Not Triggered**	NA	NA	NA
Storage Stability	Soil (supports 835.6100)	Yes	**Complete**	51459318	Acceptable	NA

Guideline Number & Study Type		Required	Data Requirement Status	MRID	DER Classification	Comments
	Water (supports 835.6200)	No[1]	**Not Triggered**	NA	NA	NA
	(supports 835.6300, 835.6400, and/or 835.7100)	No[1]	**Not Triggered**	NA	NA	NA
835.6400 - Combination and Tank Mixes		No[1]	**Not Triggered**	NA	NA	NA

NA =not applicable

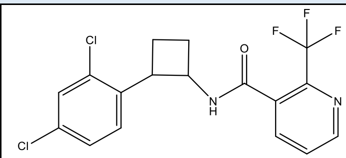
1 Per 40 CFR Part 158, specified conditions to require the study are not met.

2 Another study (MRID 51460203) was submitted by the registrant to provide supplemental information to the guideline aerobic soil metabolism studies. It provides additional information on aerobic soil metabolism, but did not fit many of the criteria for a 835.4100 guideline study.

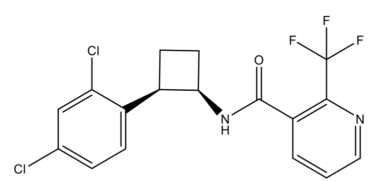
4 Additionally, 835.4100 studies (MRID 51460206 and 51460207) were received with the degradates SYN510275 and SYN549104, respectively, applied (not parent cyclobutrifluram). These studies were reviewed and is classified as supplemental.

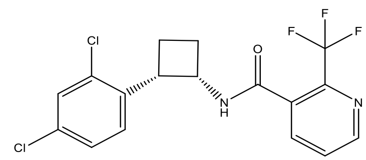
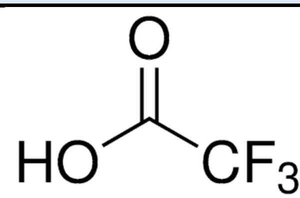
Appendix B. ROCKS table

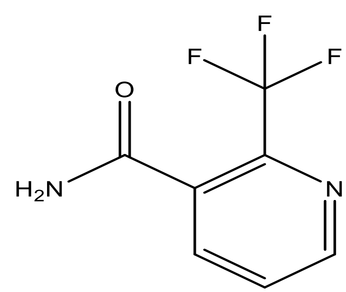
Appendix B Table 1. Cyclobutrifluram and its Environmental Transformation Products: Chemistry and Occurrence Summary in Fate Studies

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
PARENT COMPOUND CHEMISTRY AND FINAL CONCENTRATION BY TEST							
Cyclobutrifluram SYN549522	**IUPAC:** Mixture comprised of 90–99% N-[(1S,2S)-2-(2,4-dichlorophenyl)cyclobutyl]-2-(trifluoromethyl)nicotinamide and 10–1% of the (1R,2R)-enantiomer **CAS:** rel-N-[(1R,2R)-2-(2,4-dichlorophenyl)cyclobutyl]-2-(trifluoromethyl)-3-pyridinecarboxamide **CAS No.:** 1460292-16-3 **Formula:** $C_{17}H_{13}Cl_2F_3N_2O$ **MW:** 389.2 g/mol **SMILES:** O=C(C1=C(C(F)(F)F)N=CC=C1)NC2C(C3=CC=C(Cl)C=C3Cl)CC2 In the registrant's naming system, SYN549522, the active ingredient, consists of a mixture of 2	 In aerobic soil metabolism, aerobic aquatic, anaerobic aquatic, anaerobic soil, and aqueous and soil photolysis studies cyclobutrifluram was either 14C-U pyridinyl or 14C U phenyl-ring labeled to facilitate tracking of its environmental fate.	Hydrolysis	51460222	pH 4, 50°C		Stable
					pH 4, 60°C		Stable
					pH 4, 70°C		Stable
					pH 7, 50°C		Stable
					pH 7, 60°C		Stable
					pH 7, 70°C		Stable
					pH 9, 50°C		Stable
					pH 9, 60°C		Stable
					pH 9, 70°C		Stable
			Aqueous Photolysis	51460223 (14C pyridinyl)	Irradiated		29.4 – 63.7 in 2 reps. (29 d)
					Dark control		Stable
			Soil Photolysis (2 radio-labels)	51460205	Dry sandy loam, Irradiated		82.7 – 94.1 (17 d)
					Dry sandy loam, dark control		106 - 110 (17 d)
					Moist sandy loam, irradiated		40.6 - 51.2 (17 d)

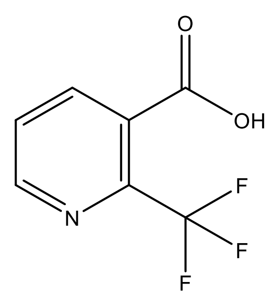
Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
Cyclobutrifluram (Contin.)	stereoisomers SYN547386 and SYN548941; further details are below.				Moist clay loam, dark control		94.6 - 100 (17 d)
			835.4100Aerobic Soil Metab. (20°C)	51460201	18 Acres Sandy clay loam soil		91 (120 d)
					East Anglia Sandy loam		79.6 (120 d)
					Sarpy Loam		92.4 (120 d)
					Capay Clay loam		92.7 (120 d)
					Gartenacker Silt loam		68.4 (120 d)
				51460202	Gartenacker silt loam		64.0 (120 d)
			Nonguideline Aerobic Soil Met	51460203	NA		NA (See below for degradate data)
			An. Soil Met. (Treated 30d prior to flooding)	51460204	18 Acres Sandy Loam		87.8 (122 d)
					Capay Clay Loam		69.8 (122 d)
					Gartenacker Silt Loam		70.6 (122 d)
					E Anglia sandy loam		74.1 (122 d)
					Sarpy silt Loam		61.9 (122 d)
			835.4300	51460220	Calwich water:Silt loam		89.7% (101 d)

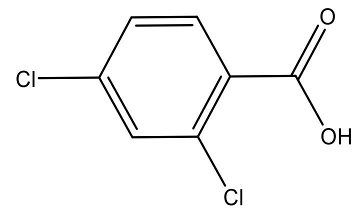
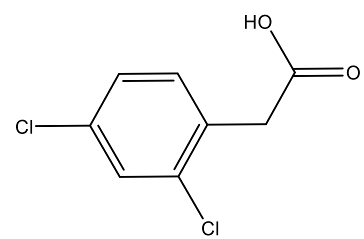
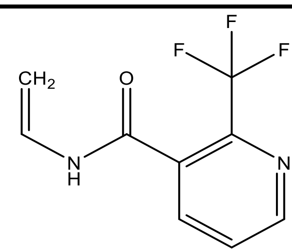
Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
			Aerobic aquatic metabolism		(Illuminated)		
					Calwich water:Silt loam (Dark)		87.9% (101 d)
					Lake water:Sand (Illuminated)		89.5% (101 d)
					Lake water:Sand (dark)		88.9% (101 d)
			Anaerobic aquatic Metabolism	51460219	Calwich water:Silt loam		91.4% (100 d)
					Lake water:Sand		100.8% (100 d)
PARENT COMPOUND ENANTIOMERS (Not separately analyzed)							
SYN548941 (R, R enantiomer of cyclobutrifluram)	**IUPAC:** N-((1R,2R)-2-(2,4-dichlorophenyl)cyclobutyl)-2-(trifluoromethyl)nicotinamide **CAS:** N-((1R,2R)-2-(2,4-dichlorophenyl)cyclobutyl)-2-(trifluoromethyl)-3-pyridinecarboxamide **Formula:** $C_{17}H_{13}Cl_2F_3N_2O$ **MW:** 389.2 g/mol **SMILES:** O=C(C1=CC=CN=C1C(F)(F)F)N[C@H]2[C@@H](C3=CC=C(Cl)C=C3Cl)CC2		835.4300 Aerobic aquatic metabolism	51460220	NA	NA	NA

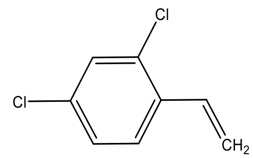
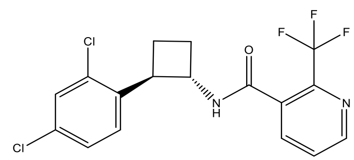
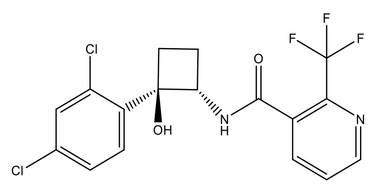
Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
SYN547386 (S, S enantiomer of cyclobutrifluram)	**IUPAC:** N-((1S,2S)-2-(2,4-dichlorophenyl)cyclobutyl)-2-(trifluoromethyl)nicotinamide **CAS:** N-((1S,2S)-2-(2,4-dichlorophenyl)cyclobutyl)-2-(trifluoromethyl)-3-pyridinecarboxamide **CAS No.:** 1644251-74-0 **Formula:** $C_{17}H_{13}Cl_2F_3N_2O$ **MW:** 389.2 g/mol **SMILES:** O=C(C1=CC=CN=C1C(F)(F)F)N[C@@H]2[C@H](C3=CC=C(Cl)C=C3Cl)CC2		835.4300 Aerobic aquatic metabolism	51460220	NA	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS (In one or more study)							
Trifluoroacetic acid Or TFA	**IUPAC:** 2,2,2-Trifluoroacetic acid **CAS No.:** 76-05-1 **Formula:** $C_2HF_3O_2$ **MW:** 114.02 g/mol **SMILES:** OC(C(F)(F)F)=O		835.4100 Aerobic. Soil Metabolism	51460201	Silt Loam (^{14}C-phenyl label)	**10.76 %** (120 d))	**10.76%** (120 d)
					Others	ND	ND
			835.4200 Anaerobic Soil Metabolism		ND	ND	ND
			Nonguideline Aerobic Soil	51460203	Sandy clay loam (Seed applied)	3.8% (68 d)	3.8% (68 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
			Column Metabolism		Clay loam (Seed applied)	4.1% (43 d)	3.4% (68 d)
					Sandy clay loam (Blank Seed applied)	3.2% (43 d)	2.6% (68 d)
					Clay loam (Blank Seed applied)	3.3% (68 d)	3.3% (68 d)
					Sandy clay loam (Drench applied)	1.0% (68 d)	1.0% (68 d)
					Clay loam (Drench applied)	1.2% (68 d)	1.2% (68 d)
TFA (continued)	**(No attempt was made to analyze for TFA in any of the field dissipation studies)**		835.6100 Terrestrial field dissipat.	51460208, -09, -10, -11, -12, and -13	Various	NR	NR
SYN510275	**IUPAC:** 2-(Trifluoromethyl)nicotinamide **CAS No.:** 959108-47-5 **Formula:** $C_7H_5F_3N_2O$ **MW:** 190.1 g/mol **SMILES:** NC(C1=C(C(F)(F)F)N=CC=C1)=O		835.2240 Aqueous photolysis	51460223	pH 7	**36.8%** (29 d)	**36.8%** (29 d)
			835.2410 Soil photolysis	51460205	Sandy loam (Dry)	4.60% (7 d)	3.07% (17 d)
					Sandy loam (Moist)	**48.8%** (17 d)	**48.8%** (17 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
SYN510275 (Contin.)			Nonguideline Aer. Soil Column Metab. (Supple-mental to 835.4100)	51460203	Sandy clay loam (Seed applied)	**NR**	**19.1%** (68 d)
					Clay loam (Seed applied)	**NR**	9.2% (68 d)
					Clay loam (Blank Seed applied)	**NR**	6.6% (68 d)
			835.6100 Terrestrial field dissipat.	51460208	Canada (Bare)	5.1% (15 d)	0.5% (486 d)
			835.6100	51460209	Georgia (Bare plot)	2.2% (28 d)	0.1% (540 d)
					Georgia (In-furrow peanut plot)	3.1% (60 d)	ND (540 d)
			835.6100	51460210	Washington (Bare plot)	1.6% (28 d)	ND (545 d)
					Washington (In-furrow potato plot)	2.7% (120 d)	ND (545 d)
			835.6100	51460211	California (Bare plot)	1.8% (58 d)	ND (539 d)
					California (In-furrow cotton plot)	2.2% (90, 181 d)	ND (539 d)
			835.6100	51460212	California (Thatch-Sod/soil)	**14.0%** (120 d; 2nd Appl)	ND (558 d)
			835.6100	51460213	Georgia	5.0%	ND

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
					(Thatch-Sod/soil)	(14 d; 2nd Appl)	(553 d)
Combined SYN510275 + SYN510260 (Not separated in the analysis)	**Information in individual chemical summaries.**		Nonguideline Aer. Soil Column Met. (Supplm. To 835.4100)	51460203	Sandy clay loam (Seed applied)	23.7% (68 d)	23.7% (68 d)
					Clay loam (Seed applied)	13.5% (43 d)	10.5% (68 d)
					Sandy clay loam (Blank Seed applied)	10.5% (43 d)	8.3% (68 d)
SYN510260	**IUPAC:** 2-(Trifluoromethyl)nicotinic acid **CAS:** 2-(Trifluoromethyl)-3-pyridinecarboxylic acid **CAS No.:** 131747-43-8 **Formula:** $C_7H_4F_3NO_2$ **MW:** 191.1 g/mol **SMILES:** O=C(O)C1=C(C(F)(F)F)N=CC=C1		835.2410 Soil photolysis	51460205	Sandy loam (Moist)	2.04% (17 d)	2.04% (17 d)
			Nonguide-line Aer. Soil Column Metab.	51460203	Clay loam (Blank Seed applied)	7.9% (68 d)	7.9% (68 d)
					Sandy clay loam (Drench applied)	**13.6%** (68 d)	**13.6%** (68 d)
					Clay loam (Drench applied)	9.4% (68 d)	9.4% (68 d)
CGA177291	**IUPAC:** 2,4-Dichlorobenzoic acid **CAS No.:** 50-84-0		835.2410	51460205	Sandy loam (Dry)	4.23% (17 d)	4.23% (17 d)

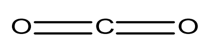
Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
	Formula: $C_7H_4Cl_2O_2$ **MW:** 191.01 g/mol **SMILES:** O=C(O)c(c(cc(c1)Cl)Cl)c1		Soil photolysis		Sandy loam (Moist)	**15.8%** (17 d)	**15.8%** (17 d)
			835.6100 Terrestrial field dissipation	51460209	Georgia (Bare plot)	2.2% (28 d)	0.1% (540 d)
					Georgia (In-furrow peanut plot)	3.1% (60 d)	ND (540 d)
			835.6100 Terrestrial field dissipation	51460208	Canada (Bare)	**10.5%** (71 d)	ND (486 d)
			835.6100 Terrestrial field dissipation	51460211	California (Bare plot)	0.1% (58 d)	ND (539 d)
EXC8199	IUPAC: 2-(2,4-Dichlorophenyl)acetic acid CAS No.: 19719-28-9 Formula: $C_8H_6Cl_2O_2$ MW: 205.03 g/mol SMILES: ClC1=CC(Cl)=C(CC(O)=O)C=C1		835.2410 Soil photolysis	51460205	Sandy loam (Moist)	**11.8%** (17 d)	**11.8%** (17 d)
			835.6100 Terrestrial field dissipation	51460209	Georgia (Bare plot)	0.08% (7 d)	ND (540 d)
SYN551231	**IUPAC:** 2-(Trifluoromethyl)-N-vinylnicotinamide **Formula:** $C_9H_7F_3N_2O$ **MW:** 216.16 g/mol **SMILES:** O=C(C1=C(C(F)(F)F)N=CC=C1)NC=C		835.2240 Aqueous photolysis	51460223	pH 7 water	**39.5%** (13 d)	**27.1%** (29 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
MINOR ONLY (<10%) TRANSFORMATION PRODUCTS							
SYN551241	**IUPAC:** 2,4-Dichloro-1-vinylbenzene **Formula:** $C_8H_6Cl_2$ **MW:** 173.04 g/mol **SMILES:** ClC1=CC=C(C=C)C(Cl)=C1		835.2240 Aqueous photolysis	51460223	pH 7	5.0% (14 d)[C]	1.7% (31 d)[C]
SYN549959 (Trans diastereomer of cyclobutrifluram not present in the active ingredient)	**1S, 2R enantiomer** **IUPAC:** N-((1S,2R)-2-(2,4-dichlorophenyl)cyclobutyl)-2-(trifluoromethyl)nicotinamide **CAS:** N-((1S,2R)-2-(2,4-dichlorophenyl)cyclobutyl)-2-(trifluoromethyl)-3-pyridinecarboxamide **Formula:** $C_{17}H_{13}Cl_2F_3N_2O$ **MW:** 389.2 g/mol **SMILES:** O=C(C1=C(C(F)(F)F)N=CC=C1)N[C@@H]2[C@@H](C3=CC=C(Cl)C=C3Cl)CC2		835.2240 Aqueous photolysis	51460223	pH 7	2.7% (31 d)[B]	2.7% (31 d)[B]
SYN549104	**IUPAC:** N-((1S,2R)-2-(2,4-dichlorophenyl)-2-hydroxycyclobutyl)-2-(trifluoromethyl)nicotinamide **Formula:** $C_{17}H_{13}Cl_2F_3N_2O_2$ **MW:** 405.2 g/mol		Nonguideline Aer. Soil Column Met.	51460203	Sandy clay loam (Seed applied)	3.8% (68 d)	3.8% (68 d)
					Clay loam (Seed applied)	2.1% (68 d)	2.1% (68 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
SYN549104 (Contin.)	**SMILES:** O=C(C1=C(C(F)(F)F)N=CC=C1)NC2C(C3=CC=C(Cl)C=C3Cl)(O)CC2						
					Sandy clay loam (Blank Seed applied)	0.7% (68 d)	0.7% (68 d)
					Clay loam (Blank Seed applied)	0.9% (26 d)	0.1% (68 d)
					Sandy clay loam (Drench applied)	0.7% (68 d)	0.7% (68 d)
			835.4100 Aerobic soil metabolism	51460203	Sandy clay loam (Seed applied)	3.8% (68 d)	3.8% (68 d)
			835.6100 Terrestrial field dissipation	51460208	Canada (Bare)	0.4% (15 d)	ND (486 d)
			835.6100 Terrestrial field dissipation	51460208	Canada (Bare)	0.4% (15 d)	ND (486 d)
			835.6100 Terrestrial field dissipat.	51460209	Georgia (Bare plot)	0.7% (90 d)	0.1% (540 d)
					Georgia (In-furrow peanut plot)	1.4% (60 d)	ND (540 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
SYN549104 (Contin.)			835.6100 Terrestrial field dissipat.	51460210	Washington (Bare plot)	1.4% (63 d)	ND (545 d)
					Washington (In-furrow potato plot)	3.7% (120 d)	ND (545 d)
			835.6100 Terrestrial field dissipation	51460211	California (Bare plot)	0.4% (29 d)	ND (539 d)
					California (In-furrow cotton plot)	2.1% (120 d)	0.1% (539 d)
			835.6100 Terrestrial field dissipation	51460212	California (Thatch-Sod/soil)	**9.9%** (7 d; 1st Appl)	0.5% (558 d)
			835.6100 Terrestrial field dissipation	51460213	Georgia (Thatch-Sod/soil)	3.6% (13 d; 1st Appl)	ND (553 d)
CARBON DIOXIDE AND UNEXTRACTED RESIDUES SUMMARY							
Unextracted Residues	N/A	N/A	835.2410 Soil photolysis	51460205	Sandy loam (Moist)	**18.6%** (17 d)	**18.6%** (17 d)
			835.4100Aerobic Soil Metab.	51460201 (^{14}C-pyridinyl label)	Sandy clay loam	**12.86%** (120 d)	**12.86%** (120 d)
					Sandy loam	**12.29%** (105 d)	8.83% (120 d)
					Clay loam	**12.76%** (63 d)	6.46% (120 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
					Silt loam	8.9 (120 d)	8.9 (120 d)
					Loam	7.1 (104 d)	4.1 (120 d)
			835.4100 (contin.)	51460202 (^{14}C-phenyl label)	Silt loam	25.6% (109 d)	21.1% (125 d)
			Nonguide-line Aerobic Soil Column Metab. (Suppl. To 835.4100)	51460203	Sandy clay loam (Seed applied)	**18.9%** (68 d)	**18.9%** (68 d)
					Clay loam (Seed applied)	**26.0%** (43 d)	**11.7%** (68 d)
					Clay loam (Blank Seed applied)	**13.2%** (43 d)	**10.3%** (68 d)
					Clay loam (Drench applied)	**24.3%** (0 d)	**10.8%** (68 d)
			835.4300 Aerobic aquatic	51460220 (combined 14C pyridinyl and 14C phenyl results)	Calwich Lake water: silt loam; illumin.	4.8% (101 d)	4.8% (101 d)
					Golden lake water: sand; illumin.	8.2% (101 d)	8.2% (101 d)
			835.4200 Anaer. Soil Metab.	51460204 (^{14}C pyridinyl except combined	Silt loam (pH 7.5) combined	**13.6%** (152 d)	**13.6%** (152 d)
					Sandy loam (6.1)	**14.9%** (152 d)	**14.9%** (152 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
				with ^{14}C phenyl where noted)	Clay loam (pH 7.0)	**24.1%** (152 d)	**24.1%** (152 d)
					Sandy loam (pH 7.1)	**19.3%** (152 d)	**19.3%** (152 d)
					Silt loam (pH 6.7)	**26.7%** (152 d)	**26.7%** (152 d)
			835.4400 Anaer. aquatic metab.	51460219 (combined 14C pyridinyl and 14C phenyl results)	Lake water:silt loam	8.18% (100 d)	8.18% (100 d)
					Lake water:loamy sand	6.56% (100 d)	6.56% (100 d)
Carbon Dioxide	**IUPAC:** Carbon dioxide **Formula:** CO_2 **MW:** 44 g/mol **SMILES:** C(=O)=O		835.2410 Soil photolysis	51460205	Sandy loam (Dry)	1.53% (17 d)	1.53% (17 d)
					Sandy loam (Moist)	1.48% (17 d)	1.48% (17 d)
			835.4100Aerobic Soil Metab.	51460201	Silt loam	2.27% (120 d)B	2.27% (120 d)B
					Other test soils	NR	NR
Carbon Dioxide (cont.)			835.4200 Anaerobic soil metabolism	51460204	Silt loam (pH 7.5)	5.4% (152 d)	5.4% (152 d)
					Sandy loam (6.1)	0.3% (30, 152 d)	0.3% (152 d)
					Clay loam (pH 7.0)	0.1% (30, 152 d)	0.1% (152 d)
					Sandy loam (pH 7.1)	0.4% (30, 152 d)	0.4% (152 d)

Code Name/Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Matrix / Conditions	Maximum %AR (day)	Final %AR (day)
					Silt loam (pH 6.7)	0.3% (152 d)	0.3% (152 d)
			835.4300 Aerobic aquatic metabolism	51460220	Lake water:Silt loam (Illuminated)	1.0% (101 d)	1.0% (101 d)
					Lake water:Silt loam (Dark)	1.3% (101 d)	1.3% (101 d)
					Lake water:Sand (Illuminated)	1.2% (101 d)	1.2% (101 d)

Appendix C. Listed Species and Critical Habitats Categorized as May Affect (MA) for Cyclobutrifluram

Appendix C Table 1. Listed and Proposed Species categorized as May Affect (MA) for Proposed Cyclobutrifluram Uses.

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
1	Indiana bat	*Myotis sodalis*	Endangered	Mammals	Indirect	Insignificant
5	Black-footed ferret	*Mustela nigripes*	Endangered	Mammals	Indirect	Insignificant
6	San Joaquin kit fox	*Vulpes macrotis mutica*	Endangered	Mammals	Indirect	Insignificant
11	Gray wolf	*Canis lupus*	Endangered	Mammals	Indirect	Insignificant
12	Gray wolf	*Canis lupus*	Threatened	Mammals	Indirect	Insignificant
15	Hawaiian hoary bat	*Lasiurus cinereus semotus*	Endangered	Mammals	Indirect	Insignificant
16	Morro Bay kangaroo rat	*Dipodomys heermanni morroensis*	Endangered	Mammals	Indirect	Insignificant
17	Salt marsh harvest mouse	*Reithrodontomys raviventris*	Endangered	Mammals	Indirect	Insignificant
20	Utah prairie dog	*Cynomys parvidens*	Threatened	Mammals	Indirect	Insignificant
21	Gray bat	*Myotis grisescens*	Endangered	Mammals	Indirect	Insignificant
22	Gulf Coast jaguarundi	*Puma yagouaroundi cacomitli*	Endangered	Mammals	Indirect	Insignificant
25	Ozark big-eared bat	*Corynorhinus (=Plecotus) townsendii ingens*	Endangered	Mammals	Indirect	Insignificant
27	Virginia big-eared bat	*Corynorhinus (=Plecotus) townsendii virginianus*	Endangered	Mammals	Indirect	Insignificant
28	Amargosa vole	*Microtus californicus scirpensis*	Endangered	Mammals	Direct	Discountable
29	Silver rice rat	*Oryzomys palustris natator*	Endangered	Mammals	Indirect	Insignificant
30	Ocelot	*Leopardus (=Felis) pardalis*	Endangered	Mammals	Indirect	Insignificant
31	Key Largo cotton mouse	*Peromyscus gossypinus allapaticola*	Endangered	Mammals	Indirect	Insignificant
32	Key Largo woodrat	*Neotoma floridana smalli*	Endangered	Mammals	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
34	Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	Endangered	Mammals	Indirect	Insignificant
35	Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	Endangered	Mammals	Indirect	Insignificant
37	Fresno kangaroo rat	*Dipodomys nitratoides exilis*	Endangered	Mammals	Indirect	Insignificant
38	Giant kangaroo rat	*Dipodomys ingens*	Endangered	Mammals	Indirect	Insignificant
39	Stephens' kangaroo rat	*Dipodomys stephensi (incl. D. cascus)*	Threatened	Mammals	Indirect	Insignificant
40	Tipton kangaroo rat	*Dipodomys nitratoides nitratoides*	Endangered	Mammals	Indirect	Insignificant
41	Alabama beach mouse	*Peromyscus polionotus ammobates*	Endangered	Mammals	Indirect	Insignificant
42	Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	Endangered	Mammals	Indirect	Insignificant
48	Mexican long-nosed bat	*Leptonycteris nivalis*	Endangered	Mammals	Indirect	Insignificant
50	Anastasia Island beach mouse	*Peromyscus polionotus phasma*	Endangered	Mammals	Indirect	Insignificant
51	Pacific pocket mouse	*Perognathus longimembris pacificus*	Endangered	Mammals	Indirect	Insignificant
52	Preble's meadow jumping mouse	*Zapus hudsonius preblei*	Threatened	Mammals	Indirect	Insignificant
53	Southeastern beach mouse	*Peromyscus polionotus niveiventris*	Threatened	Mammals	Indirect	Insignificant
54	St. Andrew beach mouse	*Peromyscus polionotus peninsularis*	Endangered	Mammals	Indirect	Insignificant
58	Buena Vista Lake ornate Shrew	*Sorex ornatus relictus*	Endangered	Mammals	Indirect	Insignificant
63	San Bernardino Merriam's kangaroo rat	*Dipodomys merriami parvus*	Endangered	Mammals	Indirect	Insignificant
66	California condor	*Gymnogyps californianus*	Endangered	Birds	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
67	Whooping crane	*Grus americana*	Endangered	Birds	Indirect	Insignificant
74	`Akohekohe (crested honeycreeper)	*Palmeria dolei*	Endangered	Birds	Indirect	Insignificant
81	Maui parrotbill (Kiwikiu)	*Pseudonestor xanthophrys*	Endangered	Birds	Indirect	Insignificant
83	Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	Endangered	Birds	Indirect	Insignificant
85	Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	Endangered	Birds	Indirect	Insignificant
86	Puaiohi	*Myadestes palmeri*	Endangered	Birds	Indirect	Insignificant
87	Micronesian megapode	*Megapodius laperouse*	Endangered	Birds	Indirect	Insignificant
89	Masked bobwhite (quail)	*Colinus virginianus ridgwayi*	Endangered	Birds	Indirect	Insignificant
91	Eskimo curlew	*Numenius borealis*	Endangered	Birds	Indirect	Insignificant
95	Ivory-billed woodpecker	*Campephilus principalis*	Endangered	Birds	Indirect	Insignificant
97	Hawaii akepa	*Loxops coccineus*	Endangered	Birds	Indirect	Insignificant
102	California clapper rail	*Rallus longirostris obsoletus*	Endangered	Birds	Indirect	Insignificant
107	Red-cockaded woodpecker	*Picoides borealis*	Endangered	Birds	Indirect	Insignificant
108	Hawaiian coot	*Fulica alai*	Endangered	Birds	Indirect	Insignificant
110	Mississippi sandhill crane	*Antigone canadensis pulla*	Endangered	Birds	Indirect	Insignificant
111	Puerto Rican nightjar	*Antrostomus noctitherus*	Endangered	Birds	Indirect	Insignificant
115	San Clemente loggerhead shrike	*Lanius ludovicianus mearnsi*	Endangered	Birds	Indirect	Insignificant
117	Yellow-shouldered blackbird	*Agelaius xanthomus*	Endangered	Birds	Indirect	Insignificant
118	Mariana (=aga) Crow	*Corvus kubaryi*	Endangered	Birds	Indirect	Insignificant
119	Guam Micronesian kingfisher	*Halcyon cinnamomina cinnamomina*	Endangered	Birds	Indirect	Insignificant
120	Mariana common moorhen	*Gallinula chloropus guami*	Endangered	Birds	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
121	Guam rail	*Rallus owstoni*	Endangered	Birds	Indirect	Insignificant
123	Least Bell's vireo	*Vireo bellii pusillus*	Endangered	Birds	Indirect	Insignificant
125	Crested caracara (Audubon''s) [FL DPS]	*Polyborus plancus audubonii*	Threatened	Birds	Indirect	Insignificant
126	Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Endangered	Birds	Indirect	Insignificant
127	Puerto Rican broad-winged hawk	*Buteo platypterus brunnescens*	Endangered	Birds	Indirect	Insignificant
129	Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Birds	Indirect	Insignificant
130	Piping Plover	*Charadrius melodus*	Endangered	Birds	Indirect	Insignificant
131	Piping Plover	*Charadrius melodus*	Threatened	Birds	Indirect	Insignificant
132	Western snowy plover	*Charadrius nivosus nivosus*	Threatened	Birds	Indirect	Insignificant
133	Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	Endangered	Birds	Indirect	Insignificant
139	golden-cheeked warbler	*Setophaga chrysoparia*	Endangered	Birds	Indirect	Insignificant
140	Florida scrub-jay	*Aphelocoma coerulescens*	Threatened	Birds	Indirect	Insignificant
142	Northern spotted owl	*Strix occidentalis caurina*	Threatened	Birds	Indirect	Insignificant
145	Coastal California gnatcatcher	*Polioptila californica californica*	Threatened	Birds	Indirect	Insignificant
148	Mariana gray swiftlet	*Aerodramus vanikorensis bartschi*	Endangered	Birds	Indirect	Insignificant
149	Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Birds	Indirect	Insignificant
151	Blunt-nosed leopard lizard	*Gambelia silus*	Endangered	Reptiles	Indirect	Insignificant
156	Puerto Rican boa	*Chilabothrus inornatus*	Endangered	Reptiles	Indirect	Insignificant
171	Ringed map turtle	*Graptemys oculifera*	Threatened	Reptiles	Indirect	Insignificant
173	Eastern indigo snake	*Drymarchon couperi*	Threatened	Reptiles	Indirect	Insignificant
175	Coachella Valley fringe-toed lizard	*Uma inornata*	Threatened	Reptiles	Indirect	Insignificant
178	blue-tailed mole skink	*Eumeces egregius lividus*	Threatened	Reptiles	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
179	Sand skink	*Neoseps reynoldsi*	Threatened	Reptiles	Indirect	Insignificant
182	bog turtle	*Glyptemys muhlenbergii*	Threatened	Reptiles	Indirect	Insignificant
183	Alameda whipsnake (=striped racer)	*Masticophis lateralis euryxanthus*	Threatened	Reptiles	Indirect	Insignificant
188	Santa Cruz long-toed salamander	*Ambystoma macrodactylum croceum*	Endangered	Amphibians	Indirect	Insignificant
190	Houston toad	*Bufo houstonensis*	Endangered	Amphibians	Indirect	Insignificant
191	Desert slender salamander	*Batrachoseps aridus*	Endangered	Amphibians	Indirect	Insignificant
192	Red Hills salamander	*Phaeognathus hubrichti*	Threatened	Amphibians	Indirect	Insignificant
193	Golden coqui	*Eleutherodactylus jasperi*	Threatened	Amphibians	Indirect	Insignificant
195	Puerto Rican crested toad	*Peltophryne lemur*	Threatened	Amphibians	Indirect	Insignificant
196	Guajon	*Eleutherodactylus cooki*	Threatened	Amphibians	Indirect	Insignificant
198	Cheat Mountain salamander	*Plethodon nettingi*	Threatened	Amphibians	Indirect	Insignificant
199	Frosted Flatwoods salamander	*Ambystoma cingulatum*	Threatened	Amphibians	Indirect	Insignificant
200	Shenandoah salamander	*Plethodon shenandoah*	Endangered	Amphibians	Indirect	Insignificant
201	Sonoran tiger salamander	*Ambystoma mavortium stebbinsi*	Endangered	Amphibians	Indirect	Insignificant
202	Wyoming Toad	*Anaxyrus baxteri*	Endangered	Amphibians	Indirect	Insignificant
203	California tiger Salamander	*Ambystoma californiense*	Endangered	Amphibians	Indirect	Insignificant
204	Arroyo (=arroyo southwestern) toad	*Anaxyrus californicus*	Endangered	Amphibians	Indirect	Insignificant
205	California red-legged frog	*Rana draytonii*	Threatened	Amphibians	Indirect	Insignificant
206	Chiricahua leopard frog	*Rana chiricahuensis*	Threatened	Amphibians	Indirect	Insignificant
207	Mountain yellow-legged frog	*Rana muscosa*	Endangered	Amphibians	Indirect	Insignificant
208	dusky gopher frog	*Rana sevosa*	Endangered	Amphibians	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
387	Morro shoulderband (=Banded dune) snail	*Helminthoglypta walkeriana*	Threatened	Terrestrial Invertebrates	Direct	Discountable
389	Chittenango ovate amber snail	*Novisuccinea chittenangoensis*	Threatened	Terrestrial Invertebrates	Direct	Discountable
390	Flat-spired three-toothed Snail	*Triodopsis platysayoides*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
391	Iowa Pleistocene snail	*Discus macclintocki*	Endangered	Terrestrial Invertebrates	Direct	Discountable
392	noonday snail	*Mesodon clarki nantahala*	Threatened	Terrestrial Invertebrates	Direct	Discountable
393	Painted snake coiled forest snail	*Anguispira picta*	Threatened	Terrestrial Invertebrates	Direct	Discountable
394	Stock Island tree snail	*Orthalicus reses (not incl. nesodryas)*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
395	Virginia fringed mountain snail	*Polygyriscus virginianus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
419	El Segundo blue butterfly	*Euphilotes battoides allyni*	Endangered	Terrestrial Invertebrates	Direct	Discountable
420	Karner blue butterfly	*Lycaeides melissa samuelis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
421	Lange's metalmark butterfly	*Apodemia mormo langei*	Endangered	Terrestrial Invertebrates	Direct	Discountable
422	Lotis blue butterfly	*Lycaeides argyrognomon lotis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
423	Mission blue butterfly	*Icaricia icarioides missionensis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
424	Mitchell's satyr Butterfly	*Neonympha mitchellii mitchellii*	Endangered	Terrestrial Invertebrates	Direct	Discountable
425	Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*	Endangered	Terrestrial Invertebrates	Direct	Discountable
426	Quino checkerspot butterfly	*Euphydryas editha quino (=E. e. wrighti)*	Endangered	Terrestrial Invertebrates	Direct	Discountable
427	San Bruno elfin butterfly	*Callophrys mossii bayensis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
428	Smith's blue butterfly	*Euphilotes enoptes smithi*	Endangered	Terrestrial Invertebrates	Direct	Discountable

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
429	Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
430	Callippe silverspot butterfly	*Speyeria callippe callippe*	Endangered	Terrestrial Invertebrates	Direct	Discountable
431	Oregon silverspot butterfly	*Speyeria zerene hippolyta*	Threatened	Terrestrial Invertebrates	Direct	Discountable
432	Palos Verdes blue butterfly	*Glaucopsyche lygdamus palosverdesensis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
433	Kern primrose sphinx moth	*Euproserpinus euterpe*	Threatened	Terrestrial Invertebrates	Direct	Discountable
434	Pawnee montane skipper	*Hesperia leonardus montana*	Threatened	Terrestrial Invertebrates	Direct	Discountable
435	Delta green ground beetle	*Elaphrus viridis*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
436	Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened	Terrestrial Invertebrates	Direct	Discountable
438	Bay checkerspot butterfly	*Euphydryas editha bayensis*	Threatened	Terrestrial Invertebrates	Direct	Discountable
440	American burying beetle	*Nicrophorus americanus*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
442	Northeastern beach tiger beetle	*Habroscelimorpha dorsalis dorsalis*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
443	Puritan tiger beetle	*Ellipsoptera puritana*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
444	Behren's silverspot butterfly	*Speyeria zerene behrensii*	Endangered	Terrestrial Invertebrates	Direct	Discountable
445	Hine's emerald dragonfly	*Somatochlora hineana*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
446	Blackburn's sphinx moth	*Manduca blackburni*	Endangered	Terrestrial Invertebrates	Direct	Discountable
447	Coffin Cave mold beetle	*Batrisodes texanus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
448	Kretschmarr Cave mold beetle	*Texamaurops reddelli*	Endangered	Terrestrial Invertebrates	Direct	Discountable

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
449	Tooth Cave ground beetle	*Rhadine persephone*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
450	Fender's blue butterfly	*Icaricia icarioides fenderi*	Threatened	Terrestrial Invertebrates	Direct	Discountable
451	Laguna Mountains skipper	*Pyrgus ruralis lagunae*	Endangered	Terrestrial Invertebrates	Direct	Discountable
452	Delhi Sands flower-loving fly	*Rhaphiomidas terminatus abdominalis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
455	Saint Francis' satyr butterfly	*Neonympha mitchellii francisci*	Endangered	Terrestrial Invertebrates	Direct	Discountable
456	Mount Hermon June beetle	*Polyphylla barbata*	Endangered	Terrestrial Invertebrates	Direct	Discountable
457	Ohlone tiger beetle	*Cicindela ohlone*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
458	Zayante band-winged grasshopper	*Trimerotropis infantilis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
459	[no common name] Beetle	*Rhadine infernalis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
460	Helotes mold beetle	*Batrisodes venyivi*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
461	[no common name] Beetle	*Rhadine exilis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
462	Carson wandering skipper	*Pseudocopaeodes eunus obscurus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
464	Bee Creek Cave harvestman	*Texella reddelli*	Endangered	Terrestrial Invertebrates	Direct	Discountable
465	Bone Cave harvestman	*Texella reyesi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
466	Tooth Cave pseudoscorpion	*Tartarocreagris texana*	Endangered	Terrestrial Invertebrates	Direct	Discountable
467	Tooth Cave spider	*Tayshaneta myopica*	Endangered	Terrestrial Invertebrates	Direct	Discountable
468	Spruce-fir moss spider	*Microhexura montivaga*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
469	Cokendolpher Cave Harvestman	*Texella cokendolpheri*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
470	Government Canyon Bat Cave spider	*Tayshaneta microps*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
471	Madla Cave Meshweaver	*Cicurina madla*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
472	Robber Baron Cave Meshweaver	*Cicurina baronia*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
473	Government Canyon Bat Cave meshweaver	*Cicurina vespera*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
1222	Nightingale reed warbler (old world warbler)	*Acrocephalus luscinia*	Endangered	Birds	Indirect	Insignificant
1237	Santa Catalina Island Fox	*Urocyon littoralis catalinae*	Threatened	Mammals	Indirect	Insignificant
1241	Rota bridled White-eye	*Zosterops rotensis*	Endangered	Birds	Indirect	Insignificant
1248	Hawaiian picture-wing fly	*Drosophila aglaia*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1249	Hawaiian picture-wing fly	*Drosophila heteroneura*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1250	Hawaiian picture-wing fly	*Drosophila montgomeryi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1251	Hawaiian picture-wing fly	*Drosophila mulli*	Threatened	Terrestrial Invertebrates	Direct	Discountable
1252	Hawaiian picture-wing fly	*Drosophila musaphilia*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1254	Hawaiian picture-wing fly	*Drosophila obatai*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1255	Hawaiian picture-wing fly	*Drosophila substenoptera*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1256	Hawaiian picture-wing fly	*Drosophila tarphytrichia*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1257	Hawaiian picture-wing fly	*Drosophila hemipeza*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1258	Hawaiian picture-wing fly	*Drosophila ochrobasis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1260	Sacramento Mountains checkerspot Butterfly	*Euphydryas anicia cloudcrofti*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1324	Silverspot	*Speyeria nokomis nokomis*	Proposed Threatened	Terrestrial Invertebrates	Direct	Discountable
1361	Blackline Hawaiian damselfly	*Megalagrion nigrohamatum nigrolineatum*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
1740	Mountain yellow-legged frog	*Rana muscosa*	Endangered	Amphibians	Indirect	Insignificant
1862	Fragile tree snail	*Samoana fragilis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1953	Pacific Hawaiian damselfly	*Megalagrion pacificum*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
1984	Hermes copper butterfly	*Lycaena hermes*	Threatened	Terrestrial Invertebrates	Direct	Discountable
1989	Lanai tree snail	*Partulina semicarinata*	Endangered	Terrestrial Invertebrates	Direct	Discountable
2144	Flying earwig Hawaiian damselfly	*Megalagrion nesiotes*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
2364	Humped tree snail	*Partula gibba*	Endangered	Terrestrial Invertebrates	Direct	Discountable
3064	Dunes sagebrush lizard	*Sceloporus arenicolus*	Proposed Endangered	Reptiles	Indirect	Insignificant
3224	Snail [no common name]	*Ostodes strigatus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
3385	Lanai tree snail	*Partulina variabilis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
3412	Dakota Skipper	*Hesperia dacotae*	Threatened	Terrestrial Invertebrates	Direct	Discountable
3849	Jemez Mountains salamander	*Plethodon neomexicanus*	Endangered	Amphibians	Indirect	Insignificant
3876	Newcomb's Tree snail	*Newcombia cumingi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
4000	Hawaiian picture-wing fly	*Drosophila digressa*	Endangered	Terrestrial Invertebrates	Direct	Discountable
4016	North American wolverine	*Gulo gulo luscus*	Proposed Threatened	Mammals	Indirect	Insignificant
4064	Gunnison sage-grouse	*Centrocercus minimus*	Threatened	Birds	Indirect	Insignificant
4090	Oregon spotted frog	*Rana pretiosa*	Threatened	Amphibians	Indirect	Insignificant
4136	Akikiki	*Oreomystis bairdi*	Endangered	Birds	Indirect	Insignificant
4228	Penasco least chipmunk	*Tamias minimus atristriatus*	Proposed Endangered	Mammals	Indirect	Insignificant
4237	Elfin-woods warbler	*Setophaga angelae*	Threatened	Birds	Indirect	Insignificant
4296	Streaked Horned lark	*Eremophila alpestris strigata*	Threatened	Birds	Indirect	Insignificant
4308	Mariana eight-spot butterfly	*Hypolimnas octocula marianensis*	Endangered	Terrestrial Invertebrates	Direct	Discountable

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
4326	Crimson Hawaiian damselfly	*Megalagrion leptodemas*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
4508	Miami Blue Butterfly	*Cyclargus (=Hemiargus) thomasi bethunebakeri*	Endangered	Terrestrial Invertebrates	Direct	Discountable
4564	Pacific sheath-tailed Bat	*Emballonura semicaudata semicaudata*	Endangered	Mammals	Indirect	Insignificant
4567	Texas kangaroo rat	*Dipodomys elator*	Proposed Endangered	Mammals	Direct	Discountable
4773	California tiger Salamander	*Ambystoma californiense*	Threatened	Amphibians	Indirect	Insignificant
4910	Salt Creek Tiger beetle	*Cicindela nevadica lincolniana*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
4936	Alligator snapping turtle	*Macrochelys temminckii*	Proposed Threatened	Reptiles	Indirect	Insignificant
5067	Bartram's hairstreak Butterfly	*Strymon acis bartrami*	Endangered	Terrestrial Invertebrates	Direct	Discountable
5168	Mariana wandering butterfly	*Vagrans egistina*	Endangered	Terrestrial Invertebrates	Direct	Discountable
5170	Friendly Ground-Dove	*Gallicolumba stairi*	Endangered	Birds	Indirect	Insignificant
5210	New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Endangered	Mammals	Indirect	Insignificant
5610	Island marble Butterfly	*Euchloe ausonides insulanus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
6097	Black pinesnake	*Pituophis melanoleucus lodingi*	Threatened	Reptiles	Indirect	Insignificant
6231	Oceanic Hawaiian damselfly	*Megalagrion oceanicum*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
6400	bog buck moth	*Hemileuca maia menyanthevora*	Endangered	Terrestrial Invertebrates	Direct	Discountable
6522	Akekee	*Loxops caeruleirostris*	Endangered	Birds	Indirect	Insignificant
6867	Orangeblack Hawaiian damselfly	*Megalagrion xanthomelas*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
6901	Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	Birds	Indirect	Insignificant
7495	Taylor's (=whulge) Checkerspot	*Euphydryas editha taylori*	Endangered	Terrestrial Invertebrates	Direct	Discountable
7800	Eastern Massasauga (=rattlesnake)	*Sistrurus catenatus*	Threatened	Reptiles	Indirect	Insignificant
7907	Guam tree snail	*Partula radiolata*	Endangered	Terrestrial Invertebrates	Direct	Discountable
7918	Snail [no common name]	*Eua zebrina*	Endangered	Terrestrial Invertebrates	Direct	Discountable
8083	Florida leafwing Butterfly	*Anaea troglodyta floridalis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
8395	California tiger Salamander	*Ambystoma californiense*	Endangered	Amphibians	Indirect	Insignificant
8503	Casey's June Beetle	*Dinacoma caseyi*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
9282	Rota blue damselfly	*Ischnura luta*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
9337	Greater sage-grouse	*Centrocercus urophasianus*	Proposed Threatened	Birds	Indirect	Insignificant
9378	Llanero Coqui	*Eleutherodactylus juanariveroi*	Endangered	Amphibians	Indirect	Insignificant
9725	Florida bonneted bat	*Eumops floridanus*	Endangered	Mammals	Indirect	Insignificant
9943	Reticulated flatwoods salamander	*Ambystoma bishopi*	Endangered	Amphibians	Indirect	Insignificant
10007	Puerto Rican harlequin butterfly	*Atlantea tulita*	Threatened	Terrestrial Invertebrates	Direct	Discountable
10043	Northern Long-Eared Bat	*Myotis septentrionalis*	Endangered	Mammals	Indirect	Insignificant
10073	`I`iwi	*Drepanis coccinea*	Threatened	Birds	Indirect	Insignificant
10078	Pacific Marten, Coastal Distinct Population Segment	*Martes caurina*	Threatened	Mammals	Indirect	Insignificant
10147	Poweshiek skipperling	*Oarisma poweshiek*	Endangered	Terrestrial Invertebrates	Direct	Discountable
10517	Sierra Nevada Yellow-legged Frog	*Rana sierrae*	Endangered	Amphibians	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for Listed Species?	Listed Species - NLAA Basis
10582	Mao (= maomao) (honeyeater)	*Gymnomyza samoensis*	Endangered	Birds	Indirect	Insignificant
10732	Slevin's skink	*Emoia slevini*	Endangered	Reptiles	Indirect	Insignificant
10909	Miami tiger beetle	*Cicindelidia floridana*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
11319	Eastern Black rail	*Laterallus jamaicensis ssp. jamaicensis*	Threatened	Birds	Indirect	Insignificant
11365	Tricolored bat	*Perimyotis subflavus*	Proposed Endangered	Mammals	Indirect	Insignificant
11653	Fisher	*Pekania pennanti*	Endangered	Mammals	Indirect	Insignificant
11657	Suwannee alligator snapping turtle	*Macrochelys suwanniensis*	Proposed Threatened	Reptiles	Indirect	Insignificant
11666	Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	Threatened	Birds	Indirect	Insignificant
11683	Foothill yellow-legged frog	*Rana boylii*	Threatened	Amphibians	Indirect	Insignificant
11684	Foothill yellow-legged frog	*Rana boylii*	Endangered	Amphibians	Indirect	Insignificant
11685	Foothill yellow-legged frog	*Rana boylii*	Endangered	Amphibians	Indirect	Insignificant
11686	Foothill yellow-legged frog	*Rana boylii*	Threatened	Amphibians	Indirect	Insignificant
11729	California spotted Owl	*Strix occidentalis occidentalis*	Proposed Endangered	Birds	Indirect	Insignificant
11730	California spotted Owl	*Strix occidentalis occidentalis*	Proposed Threatened	Birds	Indirect	Insignificant

Appendix C Table 2. Designated and Proposed CHs categorized as May Affect (MA) for Proposed Cyclobutrifluram Uses.

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
1	Indiana bat	*Myotis sodalis*	Endangered	Mammals	Indirect	Insignificant
2	Grizzly bear	*Ursus arctos horribilis*	Threatened	Mammals	Indirect	Insignificant
11	Gray wolf	*Canis lupus*	Endangered	Mammals	Indirect	Insignificant
12	Gray wolf	*Canis lupus*	Threatened	Mammals	Indirect	Insignificant
16	Morro Bay kangaroo rat	*Dipodomys heermanni morroensis*	Endangered	Mammals	Both	Insignificant
27	Virginia big-eared bat	*Corynorhinus (=Plecotus) townsendii virginianus*	Endangered	Mammals	Indirect	Insignificant
28	Amargosa vole	*Microtus californicus scirpensis*	Endangered	Mammals	Indirect	Insignificant
37	Fresno kangaroo rat	*Dipodomys nitratoides exilis*	Endangered	Mammals	Both	Discountable (direct); Insignificant (indirect)
41	Alabama beach mouse	*Peromyscus polionotus ammobates*	Endangered	Mammals	Both	Insignificant
66	California condor	*Gymnogyps californianus*	Endangered	Birds	Indirect	Insignificant
67	Whooping crane	*Grus americana*	Endangered	Birds	Indirect	Insignificant
79	Palila (honeycreeper)	*Loxioides bailleui*	Endangered	Birds	Indirect	Insignificant
110	Mississippi sandhill crane	*Antigone canadensis pulla*	Endangered	Birds	Indirect	Insignificant
117	Yellow-shouldered blackbird	*Agelaius xanthomus*	Endangered	Birds	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
132	Western snowy plover	*Charadrius nivosus nivosus*	Threatened	Birds	Indirect	Insignificant
163	St. Croix ground lizard	*Ameiva polops*	Endangered	Reptiles	Indirect	Insignificant
170	Plymouth Redbelly Turtle = Plymouth Redbelly Cooter	*Pseudemys rubriventris bangsi*	Endangered	Reptiles	Indirect	Insignificant
175	Coachella Valley fringe-toed lizard	*Uma inornata*	Threatened	Reptiles	Indirect	Insignificant
176	American crocodile	*Crocodylus acutus*	Threatened	Reptiles	Indirect	Insignificant
188	Santa Cruz long-toed salamander	*Ambystoma macrodactylum croceum*	Endangered	Amphibians	Indirect	Insignificant
190	Houston toad	*Bufo houstonensis*	Endangered	Amphibians	Indirect	Insignificant
193	Golden coqui	*Eleutherodactylus jasperi*	Threatened	Amphibians	Indirect	Insignificant
199	Frosted Flatwoods salamander	*Ambystoma cingulatum*	Threatened	Amphibians	Indirect	Insignificant
387	Morro shoulderband (=Banded dune) snail	*Helminthoglypta walkeriana*	Threatened	Terrestrial Invertebrates	Direct	Discountable
419	El Segundo blue butterfly	*Euphilotes battoides allyni*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
420	Karner blue butterfly	*Lycaeides melissa samuelis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
421	Lange's metalmark butterfly	*Apodemia mormo langei*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
422	Lotis blue butterfly	*Lycaeides argyrognomon lotis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
423	Mission blue butterfly	*Icaricia icarioides missionensis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
426	Quino checkerspot butterfly	*Euphydryas editha quino (=E. e. wrighti)*	Endangered	Terrestrial Invertebrates	Direct	Discountable
427	San Bruno elfin butterfly	*Callophrys mossii bayensis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
428	Smith's blue butterfly	*Euphilotes enoptes smithi*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
430	Callippe silverspot butterfly	*Speyeria callippe callippe*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
431	Oregon silverspot butterfly	*Speyeria zerene hippolyta*	Threatened	Terrestrial Invertebrates	Direct	Discountable
432	Palos Verdes blue butterfly	*Glaucopsyche lygdamus palosverdesensis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
433	Kern primrose sphinx moth	*Euproserpinus euterpe*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
434	Pawnee montane skipper	*Hesperia leonardus montana*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
435	Delta green ground beetle	*Elaphrus viridis*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
436	Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
438	Bay checkerspot butterfly	*Euphydryas editha bayensis*	Threatened	Terrestrial Invertebrates	Direct	Discountable
445	Hine's emerald dragonfly	*Somatochlora hineana*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (indirect)
446	Blackburn's sphinx moth	*Manduca blackburni*	Endangered	Terrestrial Invertebrates	Direct	Discountable
450	Fender's blue butterfly	*Icaricia icarioides fenderi*	Threatened	Terrestrial Invertebrates	Direct	Discountable
451	Laguna Mountains skipper	*Pyrgus ruralis lagunae*	Endangered	Terrestrial Invertebrates	Direct	Discountable
458	Zayante band-winged grasshopper	*Trimerotropis infantilis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
459	[no common name] Beetle	*Rhadine infernalis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
460	Helotes mold beetle	*Batrisodes venyivi*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
461	[no common name] Beetle	*Rhadine exilis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
463	Kauai cave wolf or pe'e pe'e maka 'ole spider	*Adelocosa anops*	Endangered	Terrestrial Invertebrates	Direct	Discountable
468	Spruce-fir moss spider	*Microhexura montivaga*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
469	Cokendolpher Cave Harvestman	*Texella cokendolpheri*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
471	Madla Cave Meshweaver	*Cicurina madla*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
472	Robber Baron Cave Meshweaver	*Cicurina baronia*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
1237	Santa Catalina Island Fox	*Urocyon littoralis catalinae*	Threatened	Mammals	Indirect	Insignificant
1248	Hawaiian picture-wing fly	*Drosophila aglaia*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1249	Hawaiian picture-wing fly	*Drosophila heteroneura*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1250	Hawaiian picture-wing fly	*Drosophila montgomeryi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1251	Hawaiian picture-wing fly	*Drosophila mulli*	Threatened	Terrestrial Invertebrates	Direct	Discountable
1252	Hawaiian picture-wing fly	*Drosophila musaphilia*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1254	Hawaiian picture-wing fly	*Drosophila obatai*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1255	Hawaiian picture-wing fly	*Drosophila substenoptera*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1256	Hawaiian picture-wing fly	*Drosophila tarphytrichia*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1257	Hawaiian picture-wing fly	*Drosophila hemipeza*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1258	Hawaiian picture-wing fly	*Drosophila ochrobasis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1260	Sacramento Mountains checkerspot Butterfly	*Euphydryas anicia cloudcrofti*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
1361	Blackline Hawaiian damselfly	*Megalagrion nigrohamatum nigrolineatum*	Endangered	Terrestrial Invertebrates	Direct	Discountable
1783	Northern Mexican gartersnake	*Thamnophis eques megalops*	Threatened	Reptiles	Indirect	Insignificant
1984	Hermes copper butterfly	*Lycaena hermes*	Threatened	Terrestrial Invertebrates	Direct	Discountable
1989	Lanai tree snail	*Partulina semicarinata*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
2238	Florida Keys mole skink	*Plestiodon egregius egregius*	Proposed Threatened	Reptiles	Indirect	Insignificant
3194	Roy Prairie pocket gopher	*Thomomys mazama glacialis*	Threatened	Mammals	Indirect	Insignificant
3385	Lanai tree snail	*Partulina variabilis*	Endangered	Terrestrial Invertebrates	Both	Discountable (direct); Insignificant (Indirect)
3412	Dakota Skipper	*Hesperia dacotae*	Threatened	Terrestrial Invertebrates	Direct	Discountable
3849	Jemez Mountains salamander	*Plethodon neomexicanus*	Endangered	Amphibians	Indirect	Insignificant
3876	Newcomb's Tree snail	*Newcombia cumingi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
4000	Hawaiian picture-wing fly	*Drosophila digressa*	Endangered	Terrestrial Invertebrates	Direct	Discountable
4136	Akikiki	*Oreomystis bairdi*	Endangered	Birds	Indirect	Insignificant
4228	Penasco least chipmunk	*Tamias minimus atristriatus*	Proposed Endangered	Mammals	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
4296	Streaked Horned lark	*Eremophila alpestris strigata*	Threatened	Birds	Indirect	Insignificant
4326	Crimson Hawaiian damselfly	*Megalagrion leptodemas*	Endangered	Terrestrial Invertebrates	Direct	Discountable
4567	Texas kangaroo rat	*Dipodomys elator*	Proposed Endangered	Mammals	Both	Discountable (direct); Insignificant (indirect)
4910	Salt Creek Tiger beetle	*Cicindela nevadica lincolniana*	Endangered	Terrestrial Invertebrates	Direct	Discountable
5067	Bartram's hairstreak Butterfly	*Strymon acis bartrami*	Endangered	Terrestrial Invertebrates	Direct	Discountable
5610	Island marble Butterfly	*Euchloe ausonides insulanus*	Endangered	Terrestrial Invertebrates	Direct	Discountable
6231	Oceanic Hawaiian damselfly	*Megalagrion oceanicum*	Endangered	Terrestrial Invertebrates	Direct	Discountable
7261	Hawaiian picture-wing fly	*Drosophila sharpi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
7495	Taylor's (=whulge) Checkerspot	*Euphydryas editha taylori*	Endangered	Terrestrial Invertebrates	Direct	Discountable
8083	Florida leafwing Butterfly	*Anaea troglodyta floridalis*	Endangered	Terrestrial Invertebrates	Direct	Discountable
8395	California tiger Salamander	*Ambystoma californiense*	Endangered	Amphibians	Indirect	Insignificant
8503	Casey's June Beetle	*Dinacoma caseyi*	Endangered	Terrestrial Invertebrates	Direct	Discountable
9337	Greater sage-grouse	*Centrocercus urophasianus*	Proposed Threatened	Birds	Indirect	Insignificant

Entity ID	Common Name	Scientific Name	ESA Listing Status	EPA Species Group	Direct or Indirect Effects for CH?	CH - NLAA Basis
9725	Florida bonneted bat	*Eumops floridanus*	Endangered	Mammals	Indirect	Insignificant
9943	Reticulated flatwoods salamander	*Ambystoma bishopi*	Endangered	Amphibians	Indirect	Insignificant
10078	Pacific Marten, Coastal Distinct Population Segment	*Martes caurina*	Threatened	Mammals	Indirect	Insignificant
10147	Poweshiek skipperling	*Oarisma poweshiek*	Endangered	Terrestrial Invertebrates	Direct	Discountable
10909	Miami tiger beetle	*Cicindelidia floridana*	Endangered	Terrestrial Invertebrates	Direct	Discountable
11666	Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	Threatened	Birds	Indirect	Insignificant

Appendix D. Listed Species and Critical Habitat Overlap Analysis and Effects Determination Workbooks

This appendix contains Excel workbooks detailing the overlap analysis and the decision-making process for effects determinations for cyclobutrifluram in the Biological Evaluation of listed species and designated critical habitats. Two workbooks have been attached to this document.

Attachment **Appendix D-1** contains the detailed overlap analysis and effects determinations for listed species.

Attachment **Appendix D-2** contains the detailed overlap analysis and effects determinations for designated critical habitats.

Appendix E. Ecotoxicity Summaries

MRIDs	Summaries
Aquatic Vertebrates	
	Freshwater Fish
51459425	In a 96-hour acute toxicity study, Fathead Minnows (*Pimephales promelas*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent control), 1,500, 3,300, 7,200, 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 700, 1,500, 3,600, 7,500, and 16,000 µg a.i./L. Based on low recoveries (46%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Mortality was 100% in the highest concentration after 24 hours and 0% in all other control and treatment groups throughout the study. Sublethal effects to equilibrium were observed in the highest treatment group prior to complete mortality; one fish had complete loss of equilibrium and three fish had partial loss of equilibrium after 6 hours. The 96-hour LC_{50} was determined to be 11,000 µg a.i./L. This study was classified as acceptable.
51459427	In a 96-hour acute toxicity study, Common Carp (*Cyprinus carpio*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent control), 1,600, 3,100, 6,300, 13,000, and 25,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 1,500, 2,700, 5,400, 12,000, and 19,000 µg a.i./L. Based on low recoveries (76%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Mortality was 29% in the highest concentration and 0% in all other control and treatment groups throughout the study. Sublethal effects to equilibrium, partial or complete loss, were observed in the two highest treatment groups; 29 - 60% of surviving fish were affected by the end of the test. The 96-hour LC_{50} was determined to be >19,000 µg a.i./L. This study was classified as acceptable.
51459423	In a 96-hour acute toxicity study, Rainbow Trout (*Oncorhynchus mykiss*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent control), 1,500, 3,300, 7,200, 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 790, 1,700, 3,900, 8,600, and 20,000 µg a.i./L. Based on low recoveries (57%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Mortality was 100% in the highest concentration after 72 hours and 0% in all other control and treatment groups throughout the study. Sublethal effects (lost equilibrium and bloated abdomens after 24 hours and all survivors at the bottom of the tank after 48 hours) were observed in the

	highest treatment group prior to complete mortality. The 96-hour LC_{50} was determined to be 13,000 µg a.i./L. This study was classified as acceptable.
51459424	In a 96-hour acute toxicity study, Fathead Minnows (*Pimephales promelas*) were exposed to SYN510275 (metabolite of cyclobutrifluram) at nominal concentrations of 0 (negative control) and 99,000 µg a.i./L. Mean-measured concentrations were determined to be <1.8 (<LOQ, negative control) and 99,000 µg a.i./L. There were no effects to mortality in the control and treatment groups. No sublethal effects were noted in the study. The 96-hour LC_{50} was determined to be >99,000 µg a.i./L. This study was classified as acceptable.
51459429	In a 32-day early life stage toxicity study, Fathead Minnows (*Pimephales promelas*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 130, 320, 800, 2,000, and 5,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 120, 300, 850, 1,900, and 4,700 µg a.i./L. No significant effects to survival, reproduction, or weight were observed during this study. Mean length was significantly reduced by 6% at 4,700 µg a.i./L. One or more deformed fish were noted during observation of sublethal effects in all treatment groups, except the highest treatment group. The 32-day NOAEC was determined to be 1,900 µg a.i./L. The study was classified as acceptable.
Estuarine/Marine Fish	
51459426	In a 96-hour acute toxicity study, Sheepshead Minnows (*Cyprinodon variegatus*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent controls), 1,500, 3,300, 7,200 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 710, 1,500, 3,500, 7,800, and 18,000 µg a.i./L. Based on low recoveries (51%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Mortality was 43% in the highest concentration and 0% in all other control and treatment groups throughout the study. Sublethal effects to equilibrium were observed in the three highest treatment groups with 100% loss of equilibrium at the highest concentration. The 96-hour LC_{50} was determined to be >18,000 µg a.i./L. This study was classified as acceptable.
51459428	In a 34-day early life stage toxicity study, Sheepshead Minnows (*Cyprinodon variegatus*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative and solvent controls), 310, 630, 1,300, 2,500, and 5,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 350, 530, 1,200, 1,900, and 4,900 µg a.i./L. No significant effects to post-hatch survival and time to hatch were observed. Significant effects to embryo hatching success (↓10%), length (↓8%), mean wet weight (↓26%), and mean dry weight (↓27%) were observed at the highest test level. At the LOAEC, 1,200 µg a.i./L (mean measured), length (↓4%), mean wet weight

	(↓13%), and mean dry weight (↓11%) were all significantly decreased. Embryo hatching success (↓10%), length (↓4%), mean wet weight (↓16%), and mean dry weight (↓16%) demonstrated obvious decreases at the lowest test level, 350 µg a.i./L. These decreases at the lowest test level were not statistically significant but may have biological relevance. The 34 day NOAEC was determined to be 530 µg a.i./L. The study was classified as supplemental, due to uncertainty related to the effects seen at the lowest test level. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).
<u>Aquatic Invertebrates</u>	
Water-Column	
51459432	In a 48-hour acute toxicity study, daphnids (*Daphnia magna*) were exposed to cyclobutrifluram under static conditions at nominal concentrations of 0 (negative and solvent controls), 1,500, 3,300, 7,200, 16,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 1,100, 2,300, 5,400, 12,000, and 27,000 µg a.i./L. Based on low recoveries (77%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. No significant effects to immobility were noted for controls (0%) or treatment groups (0 to 10%) after 48 hours of exposure. At the highest concentration tested, lethargy was observed in 100% of organisms surviving until the end of the study. The 48-hour EC_{50} was determined to be >27,000 µg a.i./L. This study was classified as acceptable.
51459433	In a 48-hour acute toxicity study, daphnids (*D. magna*) were exposed to SYN510275 (metabolite of cyclobutrifluram) at nominal concentrations of 0 (negative control) and 99,000 µg a.i./L (102,000 µg a.i./L mean-measured). There were no effects to immobility in the control and treatment groups. No sublethal effects were noted in the study. The 48-hour EC_{50} was determined to be >102,000 µg a.i./L. This study was classified as acceptable.
51459436	In a 21-day full life cycle toxicity study, daphnids (*D. magna*) were exposed to cyclobutrifluram under static renewal conditions at nominal concentrations of 0 (negative control), 630, 1,300, 2,500, 5,000, and 10,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 660, 1,400, 2,600, 5,300, and 11,000 µg a.i./L. Survival ranged from 80 - 100% in the treatment groups compared to 100% in the control group. Significant effects to length (↓4%), number of offspring per surviving female (↓18%), successful birthrate (↓15%), and time to first brood (↑5%) were observed at 1,400 µg a.i./L. The 21-day NOAEC was determined to be 660 µg a.i./L. This study was classified as acceptable. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.
51459434	In a 96-hour acute toxicity study, Eastern Oysters (*Crassostrea virginica*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 31, 63, 130, 250, and 500 µg a.i./L. Mean-measured concentrations were

	determined to be <0.050 (<LOQ, control), 37, 67, 120, 240, and 490 µg a.i./L. Concentrations were unstable at the lowest two concentrations (64 and 74% recoveries). Mortality was not observed in the control or treatment groups. Significant effects to shell deposition were observed; shell deposition was 2.3, 2.5, 2.1, 1.7, 1.6, and 0.65 mm for <0.050 (<LOQ, control), 37, 67, 120, 240, and 490 µg a.i./L exposure concentrations, respectively. At the two highest treatment groups, sublethal effects to feeding were observed. The 96-hour IC_{50} was determined to be 290 µg a.i./L. The study was classified as supplemental, because the test substance was unstable at the two lowest test levels. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).
51459469	In a 96-hour acute toxicity study, mysids (*Americamysis bahia*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 560, 1,100, 2,300, 4,500, and 9,000 µg a.i./L. Mean-measured concentrations were determined to be <250 (<LOQ, control), 500, 1,000, 2,000, 4,100, and 8,000 µg a.i./L. Mortality was 0, 0, 0, 5, 10, 15% in the <250 (<LOQ, control), 500, 1,000, 2,000, 4,100, and 8,000 µg a.i./L treatment groups, respectively. Sublethal effects, surfacing and lethargy, were observed in the 3 highest treatment groups. The 96-hour EC_{50} was determined to be >8,000 µg a.i./L. This study was classified as acceptable.
51459435	In a 28-day flow through life cycle toxicity study, mysids (*Americamysis bahia*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 78, 160, 310, 630, 1,300, and 2,500 µg a.i./L. Mean-measured concentrations were determined to be <25 (<LOQ, control), 79, 160, 310, 630, 1,300, and 2,400 µg a.i./L. Survival ranged from 88.3 - 100% in the treatment groups compared to 96.7% in the control group. Significant effects to time to first brood (↓17%) and male body length (↓3%) were observed at 310 and 2,400 µg a.i./L, respectively. The 28-day NOAEC was determined to be 160 µg a.i./L based on time to first brood. The study was classified as supplemental, because the number of subjects per replicate were highly inconsistent or greater than guideline recommendations. It is suitable for quantitative use. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant biologically relevant effects were observed.
Benthic	
51459443	In a 10-day subchronic toxicity study, freshwater amphipods (*Hyalella azteca*) were exposed to sediment applied cyclobutrifluram under intermittent renewal (of overlying water) conditions at nominal concentrations of 0 (solvent control), 5,000, 10,000, 20,000, 40,000, and 80,000 µg a.i./kg. Mean-measured concentrations were determined to be <50 (<LOQ, control), 4,100, 9,500, 18,000, 38,000, and 73,000 µg a.i./kg for sediment and <LOQ, 240, 560, 1,300, 3,200, and 7,700 µg a.i./L for pore water. Survival ranged from 94 to 99% and dry weight ranged from 0.14 - 0.15 mg in control and treatment groups. The 10-day NOAEC was determined to be 73,000 µg a.i./kg (7,700 µg a.i./L). This study was classified as acceptable.

51459444	In a 10-day subchronic toxicity study, the freshwater midge (*Chironomus dilutus*) was exposed to sediment applied cyclobutrifluram under intermittent renewal (of overlying water) conditions at nominal concentrations of 0 (solvent control), 5,000, 10,000, 20,000, 40,000, and 80,000 µg a.i./kg. Mean-measured concentrations were determined to be <50 (<LOQ, control), 4,500, 9,000, 20,000, 36,000, and 73,000 µg a.i./kg for sediment and <LOQ, 410, 940, 2,000, 4,100, and 10,000 µg a.i./L for pore water. No significant effects to dry weight were observed. Survival ranged from 31 to 86% in the treatment groups compared to 90% in the control group with significant effects noted at 9,000, 36,000, and 73,000 µg a.i./kg. The 10-day NOAEC was determined to be 4,500 µg a.i./kg (410 µg a.i./L). This study was classified as acceptable. This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.
51459445	In a 10-day subchronic toxicity study, estuarine amphipods (*Leptocheirus plumulosus*) were exposed to sediment applied cyclobutrifluram under intermittent renewal (of overlying water) conditions at nominal concentrations of 0 (solvent control), 6,300, 13,000, 25,000, 50,000, and 100,000 µg a.i./kg. Mean-measured concentrations were determined to be <50 (<LOQ, control), 4,100, 8,000, 16,000, 30,000, and 62,000 µg a.i./kg for sediment and <LOQ, 210, 460, 950, 2,200, and 4,500 µg a.i./L for pore water. Survival ranged from 85 to 92% in treatment groups compared to 86% in the control group. The 10-day NOAEC was determined to be 62,000 µg a.i./kg (4,500 µg a.i./L). This study was classified as acceptable.
Terrestrial Vertebrates	
	Avian
51459413 51459414 51459415	In three separate 14-day acute oral toxicity studies, three species of birds, Northern Bobwhite (*Colinus virginianus*), Mallard Duck (*Anas platyrhynchos*), and Canary (*Serinus canaria*), were administered cyclobutrifluram (TGAI) at nominal concentrations of 0 (negative control) and 2000 mg a.i./kg bw. At 14 days in all studies, there were no effects to mortality in the control and treatment groups and no sublethal effects to body weight. In the mallard study, regurgitation was observed in one treatment group replicate after administration of the test substance but not at any other time in the study. The 14-day LD_{50} was determined to be >2000 mg a.i./kg bw for each study. These studies were classified as acceptable.
51459422	In an 8-day dietary study, Northern Bobwhite Quail were administered diets containing cyclobutrifluram (TGAI) at nominal concentrations of 0 (solvent control), 562, 1000, 1780, 3160, and 5620 mg a.i./kg diet for 5 days followed by a 3-day recovery period. Mean-measured concentrations were determined to be <100 (<LOQ, solvent control), 577, 980, 1760, 2975, and 5259 mg a.i./kg diet. One mortality was observed throughout the test and occurred on day 2 in the highest treatment group; this mortality was noted as being most likely due to pen mate aggression and was not considered treatment related. No

	sublethal effects to body weight were noted in the study. Several behavior abnormalities and lesions were noted in the treatment groups at the end of the test. The 8-day dietary LC_{50} was determined to be >5259 mg a.i./kg diet. This study was classified as acceptable.
51459421	In an 8-day dietary toxicity study, Mallard Duck were administered diets containing cyclobutrifluram at nominal concentrations of 0 (solvent control), 562, 1000, 1780, 3160, and 5620 mg a.i./kg diet for 5 days followed by a 3 day recovery period. Mean-measured concentrations were determined to be <100 (<LOQ, solvent control), 572, 1052, 1768, 2960, and 5245 mg a.i./kg diet. At 8 days, there were no effects to mortality in the control and treatment groups. Sublethal effects to body weight change were noted in the study. The 8-day dietary LC_{50} was determined to be >5245 mg a.i./kg diet. This study was classified as acceptable.
51459419	In a 21-week reproduction study, Northern Bobwhite Quail were administered diets containing cyclobutrifluram at nominal concentrations of 0 (control), 403, 805, and 2013 mg a.i./kg diet. Mean-measured concentrations were determined to be <100 (<LOQ, control), 390, 777, and 1899 mg a.i./kg diet. At 21 weeks, there were no treatment related effects to reproduction and mortality in the control and treatment groups and no signs of overt toxicity. Incidental mortalities and injuries were noted throughout the study. The 21-week reproduction NOAEC/LOAEC was determined to be 1899/>1899 mg a.i./kg diet. This study was classified as acceptable.
51459420	In a 22-week reproduction study, Mallard Duck were administered diets containing cyclobutrifluram at nominal concentrations of 0 (control), 403, 805, and 2013 mg a.i./kg diet. Mean-measured concentrations were determined to be <100 (<LOQ, control), 397, 775, and 1935 mg a.i./kg diet. At 22 weeks, there were no treatment related effects to reproduction and mortality in the control and treatment groups. Incidental injuries were noted throughout the study. The 22-week reproduction NOAEC/LOAEC was determined to be 1935/>1935 mg a.i./kg diet. This study was classified as acceptable.
Terrestrial Invertebrates	
Honey Bee – Tier I	
51459447	In a 48-hour acute oral and contact toxicity study, adult honey bees (*Apis mellifera*) were exposed to cyclobutrifluram at nominal doses of 0 (negative and solvent controls), 4.38, 8.75, 17.5, 35.0, and 70.0 µg a.i./bee, corresponding to nominal actual intake doses of 4.54, 8.97, 18.39, 36.44, and 72.23 µg a.i./bee for the oral test, and nominal doses of 0 (negative and solvent controls), 12.5, 25.0, 50.0, 100, and 200 µg a.i./bee for the contact test. No mortalities were observed during the oral test, and mortality during the contact test reached 3%. At the two lowest test levels in the oral test, one

	affected bee at each level was noted. For the contact test, one apathetic[29] bee was noted at the highest test level, and one affected bee was noted at the median test level. The 48-hour LD_{50} was determined to be >72.23 µg a.i./bee for the oral test and >200 µg a.i./bee for the contact test. The study was classified as supplemental, because random assignment and age of bees were not reported. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).
51459452	In a 72-hour acute larval toxicity test, honey bee larvae were exposed to negative and solvent controls and cyclobutrifluram at nominal doses of 2.50, 5.00, 10.0, 20.0, and 30.0 µg a.i./larva, corresponding to measured dietary doses of 2.53, 5.25, 10.1, 19.4, and 30.9 µg a.i./larva. Mortality was not observed in the control groups and ranged from 4 to 15% in the treatment groups. At the end of the test, the number of bees with unconsumed diet ranged from 11 to 17 bees in the controls and 18 to 23 in the treatment groups. The 72-hour LD_{50} was determined to be >30.9 µg a.i./larva. The study was classified as supplemental, due to uncertainty related to the unconsumed diets. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).
51459451	In a 10-day chronic feeding test, adult honey bees were exposed to negative and solvent controls and cyclobutrifluram at nominal actual intake doses of 0.44, 0.83, 1.48, 3.39, and 6.11 µg a.i./bee/day, corresponding to measured actual intake doses of 0.44, 0.84, 1.3, 3.1, and 5.9 µg a.i./bee/day. Mortality in the negative control was 5% and was 15% in the solvent control. Mortality ranged from 5 to 20% in the treatment groups and was not significantly different from controls. When compared to the negative control, the NOAEL for food consumption was non-definitive, as significant effects were observed in the solvent control (38% reduction) and all treatment groups. As this is most likely a result of the solvent and thickening agent used in the solvent control and test groups, food consumption was reanalyzed using the solvent control instead of the negative control; no significant effects to food consumption were identified for this reanalysis. The 10-day NOAEL was determined to be 5.9 µg a.i./bee/day. The study was classified as supplemental, because mortality in the solvent control is at the validity criteria threshold and there is uncertainty around the food consumption endpoint, as food consumption was significantly different between the negative and solvent controls. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).
51459453	In a 22-day chronic toxicity test, honey bee larvae were exposed, from day 3 to day 6 of the study, to negative and solvent controls and cyclobutrifluram at nominal daily dietary doses of 0.16, 0.393, 0.985, 2.47, and 6.15 µg

[29] Apathy in bee studies is defined as bees that show only low or delayed reactions to stimulation (light or puff of air); bees are sitting motionless in the unit.

	a.i./larva/day, corresponding to measured daily dietary doses of 0.16, 0.428, 1.01, 2.4, and 5.9 µg a.i./larva/day. After the exposure period, observation continued until day 22. Day 8 mortality (↑19%) was significantly increased at 5.9 ug a.i./larva/day, the highest treatment level. Significant effects to Day 15 mortality (↑41%) and Day 22 Adult Emergence (↓41%) were observed at 0.428 µg a.i./larva/day. Unconsumed diet was noted in all groups (6 to 13 larvae per group) except the negative control. The 22-day NOAEL was determined to be 0.16 µg a.i./larva/day. The study was classified as supplemental, due to uncertainty around the unconsumed diets. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates). This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.
Honey Bee – Tier II	
51459450	One study assessing cucumber pollen and nectar residues following soil applications of cyclobutrifluram at 0.178 lb a.i./A was submitted. The study was conducted across three field locations with three varieties of cucumber. The largest residue detections were from pollen samples across all sites, with the maximum mean (0.113 mg/kg) being detected 33 days after the last application in Trial 003. All nectar residues were below the limit of quantitation except one sample in Trial 003 at 33 days after the last application, which had a mean maximum of 0.0123 mg/kg. Other matrices were sampled during this study, but due to low recoveries in pollen and nectar, they were not analyzed. The study was classified as supplemental, and Trial 001 and Trial 003 were suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates); Trial 002 was only apt for qualitative use (*i.e.*, not suitable for calculation of risk estimates), due to several limitations and inconsistencies with the other trials.
Earthworm	
51459471	In a 56-day subchronic toxicity study, Earthworms (*Eisenia Andrei*) were exposed to nominal concentrations of cyclobutrifluram TGAI at 0 (negative control), 16.3, 29.4, 52.9, 95.3, 171, 309, 556, and 1000 mg a.i./kg dry weight (dw) soil. There were no significant effects to survival, body weight, or number of unhatched cocoons. Significant effects to the number of juveniles on day 56 were observed at 309 (↓23%), 556 (↓53%), and 1000 (↓78%) mg a.i./kg dw soil. The 56-day NOAEC was determined to be 171 mg a.i./kg dw soil. This study was classified as acceptable.
51459458	In a 56-day subchronic toxicity study, Earthworms (*E. Andrei*) were exposed to nominal concentrations of SYN549522 SC (A22011B; a.i. cyclobutrifluram, 38.1% (w/w)) at 0 (negative control), 6.21, 11.2, 20.2, 36.3, 65.2, 118, 212, and 381 mg a.i./kg dry weight (dw) soil. There were no significant effects to mortality, body weight, or number of unhatched cocoons. Significant effects to the number of juveniles on day 56 were observed at 212 (↓40%) and 381

	(↓76%) mg a.i./kg dw soil. The 56-day NOAEC was determined to be 118 mg a.i./kg dw soil. This study was classified as acceptable.
51459459	In a 56-day subchronic toxicity study, Earthworms (*E. Andrei*) were exposed to nominal concentrations of SYN549522 FS (A22417C; a.i. cyclobutrifluram, 41.4% (w/w)) at 0 (negative control), 6.75, 12.2, 21.9, 39.5, 70.8, 128, 230, and 414 mg a.i./kg dry weight (dw) soil. There were no significant effects to mortality, body weight, or number of unhatched cocoons. Significant effects to the number of juveniles on day 56 were observed at 128 (↓21%), 230 (↓42%), and 414 (↓66%) mg a.i./kg dw soil. The 56-day NOAEC was determined to be 70.8 mg a.i./kg dw soil. This study was classified as acceptable.
51459470	In a 14-day acute toxicity study, Earthworms (*E. Andrei*) were exposed to nominal concentrations of cyclobutrifluram TGAI at 0 (negative control), 62.5, 125, 250, 500, and 1000 mg a.i./kg dry weight (dw) soil. There were no significant effects to mortality. Significant effects to body weight change (↑68%) were observed at 1000 mg a.i./kg dw soil. The 14-day NOAEC was determined to be 500 mg a.i./kg dw soil. This study was classified as acceptable.
Other Terrestrial Invertebrates	
51459454	In a 13-day acute toxicity study, the Parasitic Wasp (*Aphidius Rhopalosiphi)* was exposed to nominal concentrations of SYN549522 SC 450 (A22011B; a.i. cyclobutrifluram, 38.1% (w/w)) at 0 (negative control), 42.0, 83.9, 168, 336, and 672 g a.i./ha as fresh dried residues on glass plates. There were no significant effects to mortality (↑16% at the highest test level) or reproduction, but reproduction was not documented for the two lowest test levels. The 48h NOAEC was determined to be 672 g a.i./ha. This study was classified as supplemental, because reproduction was not assessed in the two lowest test levels. It is suitable for quantitative purposes (*i.e.*, suitable for calculation of risk estimates).
51459455	In a 14-day acute toxicity study, the Parasitic Mite (*Typhlodromus pyri)* was exposed to nominal concentrations of SYN549522 SC 450 (A22011B; a.i. cyclobutrifluram, 38.1% (w/w)) at 0 (negative control), 42.0, 83.9, 168, 336, and 672 g a.i./ha as fresh dried residues on glass plates. There were no significant effects to mortality (↑12% at 83.9 g a.i./ha). Significant effects were noted for reproduction. There was an inverse dose response with significant effects observed at 168 (↓46%) and 336 (↓27%) g a.i./ha but not at the highest test level (↓11%). Reproduction was not assessed for the two lowest test levels. The 14-d NOAEC was determined to be <168 g a.i./ha. This study was classified as supplemental, because reproduction was not assessed in the two lowest test levels resulting in an undefined NOAEC. It is suitable for qualitative purposes (*i.e.*, not suitable for calculation of risk estimates).
51459456	In a 14-day acute toxicity study, the Parasitic Mite (*Hypoaspis aculeifer)* was exposed to nominal concentrations of SYN549522 FS (A22417C; a.i.

	cyclobutrifluram, 41.4% (w/w)) at 0 (negative control), 6.75, 12.2, 21.9, 39.5, 70.8, 128, 230, and 414 mg a.i./kg dry weight (dw) soil in artificial soil substrate under static conditions. Effects were not dose responsive, but there were no significant effects to mortality or reproduction. The 14-d NOAEC was determined to be 414 mg a.i./kg dw soil. This study was classified as supplemental due to lack of dose response. It is suitable for quantitative use (*i.e.*, suitable for calculation of risk estimates).
Aquatic and Terrestrial Plants	
	Aquatic Vascular
51459446	In a 7-day toxicity test, duckweed was exposed to cyclobutrifluram, under static renewal conditions, at nominal concentrations of 0 (negative control), 270, 640, 1,600, 4,000, 10,000, and 25,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, negative control), 250, 570, 1,400, 3,600, 9,700, and 16,000 µg a.i./L. Based on low recoveries (64%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Frond yield, final biomass, and growth rate (frond number and biomass) were all significantly affected in at least one treatment group. In comparison to control, percent inhibition to frond number, the most sensitive endpoint, ranged from -3 to 60% for the treatment groups. The 7-day IC_{50} and NOAEC were determined to be 11,000 µg a.i./L and 570 µg a.i./L, respectively. This study was classified as acceptable.
	Aquatic Non-Vascular
51459438	In a 96-hour toxicity study, freshwater algae (*Raphidocelis subcapitata*) were exposed to cyclobutrifluram at nominal concentrations of 0 (negative and solvent control), 900, 2,200, 5,600, 14,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 620, 1,400, 3,600, 8,900, and 22,000 µg a.i./L. Based on low recoveries (63%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Yield, growth rate, and AUC were all significantly inhibited in the two highest treatment groups. In comparison to negative control, % inhibition to AUC, the most sensitive endpoint, ranged from -5 to 98% for the treatment groups. The 96-hour IC_{50} and NOAEC were determined to be 7,000 µg a.i./L and 3,600 µg a.i./L, respectively. This study was classified as acceptable.
51459441	In a 96-hour toxicity study, marine diatom (*Skeletonema costatum*) cultures were exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 1,600, 3,100, 6,300, 13,000, and 25,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, control), 1,200, 2,500, 4,900, 10,000, and 13,000 µg a.i./L. Based on low recoveries (52%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Yield, Growth Rate, and AUC were all significantly inhibited in at least one treatment group. In

	comparison to negative control, % inhibition to AUC, the most sensitive endpoint, ranged from 0 to 34% for the treatment groups. The 96-hour IC_{50} and NOAEC were determined to be >13,000 µg a.i./L and 4,900 µg a.i./L, respectively. This study was classified as acceptable.
51459440	In a 96-hour toxicity study, Cyanobacteria (*Anabaena flos-aquae*) cultures were exposed to cyclobutrifluram at nominal concentrations of 0 (negative and solvent control), 900, 2,200, 5,600, 14,000, and 35,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 630, 1,500, 3,800, 9,100, and 24,000 µg a.i./L. Based on low recoveries (69%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. No effects to Yield, Growth Rate, and AUC were observed throughout the study; all endpoints were noted to have a promotion in growth for several test groups, as percent inhibition ranged from -25 to 6% in the treatment groups across all endpoints. The 96-hour IC_{50} and NOAEC were determined to be >24,000 µg a.i./L and 24,000 µg a.i./L, respectively. This study was classified as acceptable.
51459442	In a 96-hour toxicity study, the freshwater diatom (*Navicula pelliculosa)* was exposed to cyclobutrifluram at nominal concentrations of 0 (negative control), 1,600, 3,100, 6,300, 13,000, and 25,000 µg a.i./L. Mean-measured concentrations were determined to be <100 (<LOQ, controls), 1,300, 2,700, 5,300, 12,000, and 17,000 µg a.i./L. Based on low recoveries (68%) between nominal and mean-measured concentrations at test initiation, the solubility limit of the test substance may have been reached. Yield, Growth Rate, and Area AUC all displayed an inverse dose response and were significantly inhibited in the two or three lowest treatment groups; therefore, a NOAEC could not be defined. In addition, as all endpoints displayed a ≤28% effect, an IC_{50} could not be determined. The 96-hour IC_{50} and NOAEC were determined to be >17,000 µg a.i./L and <1,300 µg a.i./L, respectively. The study was classified as supplemental, because the NOAEC for all endpoints was undefined and there were several guideline deviations. It is only suitable for qualitative use (*i.e.*, not suitable for calculation of risk estimates). This study lacked a consistent dose response; the LOAEC was set to the lowest concentration where significant effects were observed.
51459439	In a 96-hour toxicity study, freshwater algae (*R. subcapitata*) were exposed to SYN510275, a metabolite of cyclobutrifluram, at nominal concentrations of 0 (negative control), 9,400, 17,000, 31,000, 55,000, and 99,000 µg a.i./L. Initial-measured concentrations were determined to be <1.8 (<LOQ, control), 9,200, 17,000, 31,000, 57,000, and 103,000 µg a.i./L. No significant effects to Yield, Growth Rate, and AUC were observed throughout the study. The 96-hour IC_{50} and NOAEC were determined to be >103,000 µg a.i./L and 103,000 µg a.i./L, respectively. This study was classified as acceptable.

Terrestrial	
51459460	In a terrestrial plant seedling emergence and seedling growth test, monocot and dicot crops were exposed to SYN549522 SC (A22011B; a.i. cyclobutrifluram, 38.7% (w/w)) at nominal concentrations ranging from 0.010 to 0.81 lb a.i./A and observed over 21 days. Concentrations were analytically confirmed in the highest test level for each crop; the highest test level measured concentration was determined to be 0.80 lb a.i./A for corn, oat, onion, ryegrass, and sugar beet and 0.81 lb a.i./A for cucumber, lettuce, oilseed rape, soybean, and tomato. Significant inhibitions to seedling emergence and survival at 0.80 lb a.i./A were noted for ryegrass only. There were no significant effects to seedling height or dry weight for any crops in the study. The 21-day NOAEC/EC_{25} for ryegrass, the most sensitive monocot crop, were determined to be 0.27 lb a.i./A and >0.80 lb a.i./A, respectively. With the exception of sugar beet, which had a NOAEC of 0.80 lb a.i./A, the NOAEC for dicot crops was determined to be 0.81 lb a.i./A. This study was classified as acceptable.
51459461	In a terrestrial plant vegetative vigor test, monocot and dicot crops were exposed, at BBCH 12 or 13, to SYN549522 SC (A22011B; a.i. cyclobutrifluram, 38.7% (w/w)) at nominal concentrations ranging from 0.010 to 0.81 lb a.i./A and observed for 21 days. Concentrations were analytically confirmed in the highest test level for each crop, and the measured concentration was determined to be 0.80 lb a.i./A for all crops tested. No significant inhibitions to survival, seedling height, or dry weight were noted for any crops in the study. The 21-day NOAEC for all species was determined to be 0.80 lb a.i./A. This study was classified as acceptable.

Appendix F. Aquatic Modeling Output and Input Batch Files

PWC Turf Sample input Files

PWC PA Turf Input File
cyclo-b_PAturf_foliar__wi Emg+14 150d step25d.pwc

```
Pesticide Water Calculator (PWC), Version 2.001
cyclo-b_PAturf_foliar
1
True
376,,,
841,,,
20,,,
1806,,,
20,,,
23.4,,,
40,,,
1E8,,,
925,,,
20,
,,,
389.2,,,
4.65E-8,,,
33,,,
0,0,
0,0,
0,0,
0,0,
0,0,
0,0,
0.0,,,
3.12E-08,,,
0.0,,,
2
2
15,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
5,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
0.252,0.252,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
False
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
2,2,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
0.99,0.99,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
.062,.062,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
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0.99,0.99,,
.062,.062,,
0.99,0.99,,
.066,.066,,
,,,
14,28,,
False, 1
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,
PAturfSTD
C:\Users\dbarrett\OneDrive - Environmental Protection Agency
(EPA)\Models(HD)\Inputs\NewScn_Mod-Eco\PATCompat_WeatherFil\19077_grid.wea
40
True,True,False,False,False,False,False
False,30,1,
True
100000
10000
0.15
0.15
1E-08
True,0.5
0.05
0.5
1.35
0.04
5
0.006
1.19
30
0.005
0.04
5
0.4
False
1.0,1.0

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True,False,False,
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False,
1,4,15,4,1,11,10,100,5,0.1,1,1,0

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,,,
0.76,0.36,12.5
*** irrigation information start ***
0
,,
False,
*** spare line for expansion
*** spare line for expansion
*** Soil Information ***
0.32,3.63,1
3,12,356.8
*** Horizon Info *******
6
2,10,15,23,54,50,
0.37,1.3,1.3,1.5,1.7,1.5,
0.47,0.33,0.33,0.31,0.24,0.21,
0.27,0.15,0.15,0.16,0.12,0.09,
7.5,1.74,1.74,0.15,0.15,0.15,
20,2,3,23,18,10,
,,,,,,
,,,,,,
*** Horizon End, Temperature Start ********
,
False
***spare line for expansion
***spare line for expansion
*** Erosion & Curve Number Info **********
26
1,16,1,16,1,15,16,1,16,1,16,1,16,1,16,1,16,1,16,1,16,1,16,1,15,16,,,,,,,,,,,,,,,,,,,,,,,,,
4,4,5,5,6,6,6,7,7,8,8,9,9,10,10,11,11,12,12,1,1,2,2,3,3,3,,,,,,,,,,,,,,,,,,,,,,,,,
74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,74,,,,,,,,,,,,,,,,,,,,,,,
,,
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015,.015,.015,.015,.015,.017,.012,,,,,,,,,,,,,,,,,,,,,,,,,
.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.110,.
110,.110,.110,.110,.110,.110,.110,,,,,,,,,,,,,,,,,,,,,,,,,
8.0,1.40,0.19,

0.1,0,1.0,
False
,,
5.0
**** Start of Batch Run Information ******

1,1,last,True,150,25,
True,1,False,False,
C:\Models\Inputs\NewScn_Mod-Eco\Pre 2020 Turf and Nursery\PAturfSTD_Pre2020_mod.SCN2

FL Turf PWC Input File:
cyclo-b_FLturf Only_foli .252kgRt_Emg+44d Wi180d Step30d.PWC
Pesticide Water Calculator (PWC), Version 2.001
cyclo-b_FLturf_foliar
1
True
376,,,
841,,,
20,,,
1806,,,
20,,,
23.4,,,
40,,,
1E8,,,
925,,,
20,
,,,
389.2,,,
4.65E-8,,,
33,,,
0,0,
0,0,
0,0,
0,0,
0,0,
0,0,
0.0,,,
3.12E-08,,,
0.0,,,
2
2
15,,,

5,,,
0.252,0.252,,
False

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0.99,0.99,,
.062,.062,,
0.99,0.99,,
.066,.066,,

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44,58,,
False, 1

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FLturfSTD
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False,30,1,
True
100000
10000
0.15
0.15
1E-08
True,0.5
0.05
0.5
1.35
0.04
5
0.006
1.19
30
0.005
0.04
5
0.4
False

1.0,1.0

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False,
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,,,
0.78,0,25
*** irrigation information start ***
0
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False,
*** spare line for expansion
*** spare line for expansion
*** Soil Information ***
0.04,0.3,1
4,2,356.8
*** Horizon Info *******
4
2,10,10,80,
0.37,1.44,1.44,1.58,
0.47,0.086,0.086,0.03,
0.27,0.036,0.036,0.023,
7.5,0.58,0.58,0.116,
20,2,2,16,
,,,,
,,,,
*** Horizon End, Temperature Start ********
,
False
***spare line for expansion
***spare line for expansion
*** Erosion & Curve Number Info **********
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1,16,1,16,1,16,1,16,1,16,1,15,16,1,16,1,16,1,16,1,16,1,16,1,16,,,,,,,,,,,,,,,,,,,,,,,,,,
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0.1,0,1.0,
False

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5.0
**** Start of Batch Run Information ******

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C:\Users\dbarrett\OneDrive - Environmental Protection Agency (EPA)\Models(HD)\Inputs\NewScn_Mod-Eco\Pre 2020 Turf and Nursery\FLturfSTD_Pre2020_mod.SCN2

PWC Ornamentals (Soil Application) Sample input File

cyclo-b_ornamentals_soil_..208kghaRt Eco+DW+Cus.PWC

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True
376,,,
841,,,
20,,,
1806,,,
20,,,
23.4,,,
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1E8,,,
925,,,
20,
,,,
389.2,,,
4.65E-8,,,
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0,0,
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0,0,
0,0,
0,0,
0.0,,,
3.12E-08,,,
0.0,,,
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2
2
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44,58,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
True, 1
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TNnurserySTD_V2
C:\Users\dbarrett\OneDrive - Environmental Protection Agency
(EPA)\Models(HD)\Inputs\NewScn_Mod-Eco\PATCompat_WeatherFil\14324_grid.wea
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0.15
1E-08
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0.5
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0.04
5
0.006
1.19
30
0.005
0.04
5
0.4
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0.75,0.16,17.5
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*** spare line for expansion
*** Soil Information ***
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*** Horizon Info *******
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1.35,1.35,1.45,1.53,
0.25,0.25,0.29,0.24,
0.1,0.1,0.14,0.16,
1.2,1.2,0.15,0.15,
100,13,19,91,
,,,,
,,,,
*** Horizon End, Temperature Start ********
,
False
***spare line for expansion
***spare line for expansion
*** Erosion & Curve Number Info **********
24
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3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,1,1,2,2,3,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
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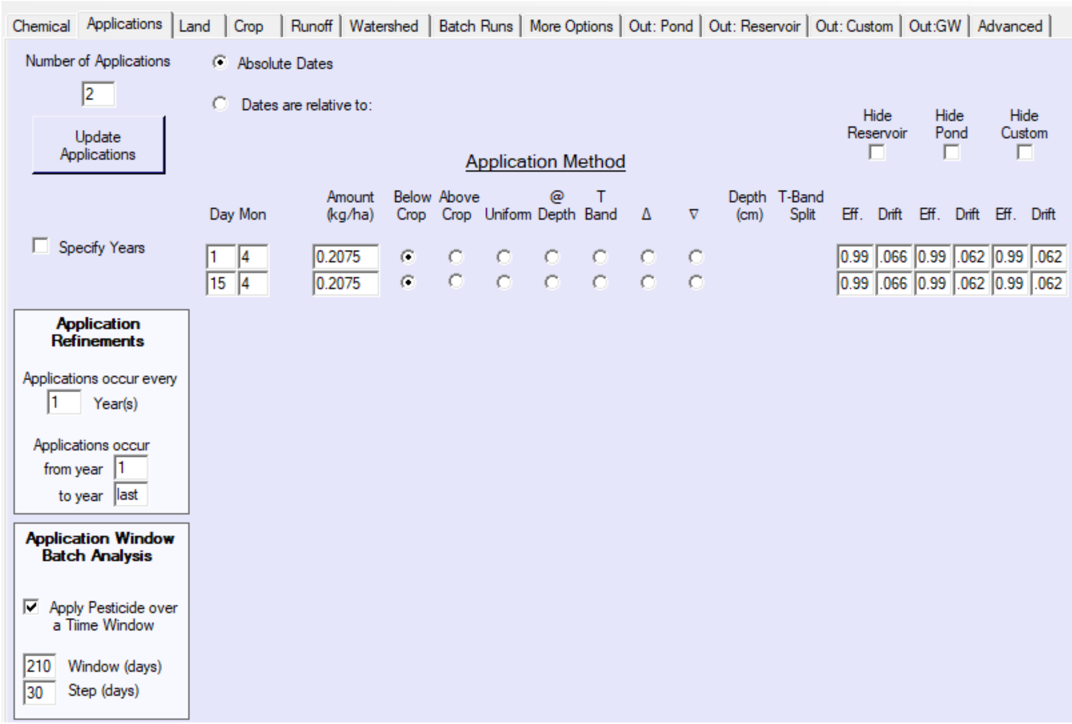
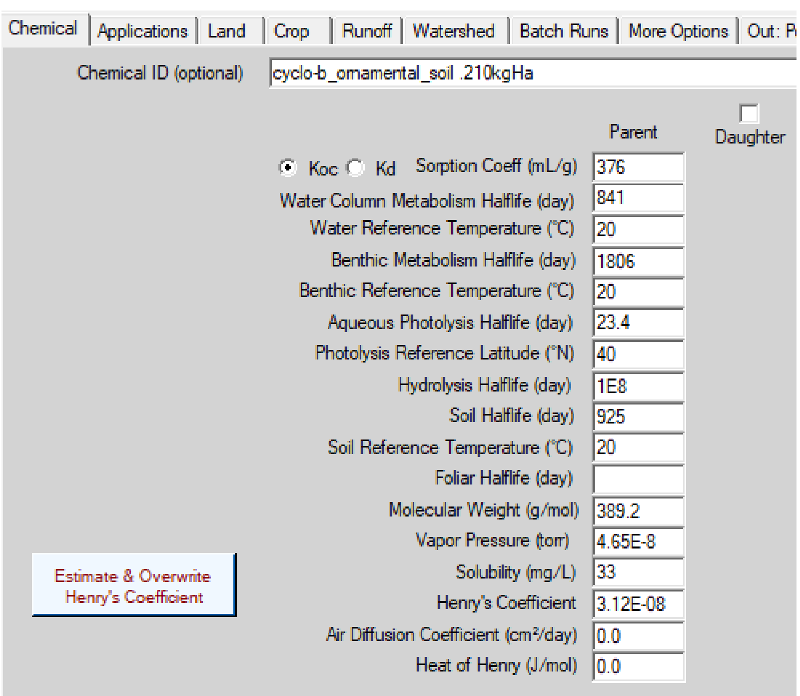
PWC Application Input Tab for Ornamentals



PWC Chemical Input Tab for Ornamentals



PWC Ornamentals EEC Output Summary File

1st Date	Scenario Name ,	1-d	4-d	21-d	60-d	90-d	365-d	Full	1-db	21-db
1-Apr	CAnurserySTD_Pre2020_mod_+0 ,	3.252	3.235	3.149	3.008	2.929	2.509	2.05	2.944	2.694
1-May	CAnurserySTD_Pre2020_mod_+30 ,	3.146	3.129	3.042	2.896	2.814	2.374	1.965	2.868	2.573
31-May	CAnurserySTD_Pre2020_mod_+60 ,	3.125	3.107	3.017	2.862	2.776	2.346	1.927	2.92	2.551
30-Jun	CAnurserySTD_Pre2020_mod_+90 ,	3.122	3.102	3.008	2.851	2.765	2.338	1.905	2.986	2.541
30-Jul	CAnurserySTD_Pre2020_mod_+120 ,	3.135	3.116	3.021	2.885	2.828	2.365	1.929	3.12	2.673
29-Aug	CAnurserySTD_Pre2020_mod_+150 ,	3.208	3.188	3.091	2.953	2.897	2.436	1.994	3.243	2.669
28-Sep	CAnurserySTD_Pre2020_mod_+180 ,	4.002	3.983	3.918	3.797	3.686	3.168	2.566	4.161	3.428
28-Oct	CAnurserySTD_Pre2020_mod_+210 ,	5.647	5.643	5.55	5.25	4.915	4.121	3.282	5.601	4.739
1-Apr	FLnurserySTD_Pre2020_mod_+0 ,	8.365	8.314	8.13	7.884	7.743	6.842	5.239	7.266	7.257
1-May	FLnurserySTD_Pre2020_mod_+30 ,	9.708	9.641	9.319	8.969	8.76	7.366	5.949	8.004	7.985
31-May	FLnurserySTD_Pre2020_mod_+60 ,	9.407	9.349	9.153	8.75	8.516	6.822	5.857	7.529	7.507
30-Jun	FLnurserySTD_Pre2020_mod_+90 ,	7.184	7.153	7.048	6.838	6.69	5.615	4.653	6.192	6.189
30-Jul	FLnurserySTD_Pre2020_mod_+120 ,	8.401	8.328	8.08	7.702	7.664	6.41	5.322	7.115	7.128
29-Aug	FLnurserySTD_Pre2020_mod_+150 ,	8.864	8.851	8.821	8.541	8.469	6.938	5.706	7.89	7.914
28-Sep	FLnurserySTD_Pre2020_mod_+180 ,	11.67	11.61	11.33	11.37	11.19	9.105	6.181	10.19	10.16
28-Oct	FLnurserySTD_Pre2020_mod_+210 ,	8.525	8.504	8.441	8.39	7.297	6.132	4.881	6.987	6.748
1-Apr	MInurserySTD_Pre2020_mod_+0 ,	12.78	12.75	12.64	12.48	12.36	11.43	9.951	11.88	11.87
1-May	MInurserySTD_Pre2020_mod_+30 ,	13.57	13.52	13.32	13.08	12.95	11.97	10.4	12.5	12.37
31-May	MInurserySTD_Pre2020_mod_+60 ,	13.64	13.59	13.4	13.19	13.06	12.33	10.62	12.64	12.62
30-Jun	MInurserySTD_Pre2020_mod_+90 ,	13.58	13.54	13.4	13.25	13.14	12.47	10.68	12.73	12.72
30-Jul	MInurserySTD_Pre2020_mod_+120 ,	14.51	14.45	14.25	14.02	13.93	13.31	11.07	13.57	13.57
29-Aug	MInurserySTD_Pre2020_mod_+150 ,	13.11	13.06	12.87	12.67	12.58	11.92	10.5	12.17	12.17
28-Sep	MInurserySTD_Pre2020_mod_+180 ,	11.9	11.88	11.79	11.71	11.55	10.97	9.194	11.28	11.25
28-Oct	MInurserySTD_Pre2020_mod_+210 ,	11.44	11.41	11.34	11.2	11.13	10.62	8.998	10.94	10.9
1-Apr	NJnurserySTD_Pre2020_mod_+0 ,	9.846	9.805	9.567	9.313	9.161	7.77	6.308	8.394	8.359
1-May	NJnurserySTD_Pre2020_mod_+30 ,	8.531	8.494	8.336	8.064	7.89	7.006	5.945	7.659	7.419

31-May	NJnurserySTD_Pre2020_mod_+60 ,	10.57	10.52	10.34	10.06	9.876	8.927	6.584	9.369	9.386
30-Jun	NJnurserySTD_Pre2020_mod_+90 ,	10.22	10.18	9.958	9.707	9.521	8.543	7.315	9.36	9.062
30-Jul	NJnurserySTD_Pre2020_mod_+120 ,	**14.09**	14.02	**13.69**	**13.2**	12.91	11.05	7.998	12.3	12.13
29-Aug	NJnurserySTD_Pre2020_mod_+150 ,	11	10.95	10.71	10.66	10.75	9.259	7.701	10.12	10.1
28-Sep	NJnurserySTD_Pre2020_mod_+180 ,	11.13	11.08	11.01	11.11	10.66	9.289	7.593	10.17	10.03
28-Oct	NJnurserySTD_Pre2020_mod_+210 ,	12.02	12.03	12.14	12.02	11.23	9.967	7.354	10.93	10.78
1-Apr	ORnurserySTD_Pre2020_mod_+0 ,	7.177	7.158	7.082	6.977	6.9	6.351	5.782	6.634	6.632
1-May	ORnurserySTD_Pre2020_mod_+30 ,	7.952	7.929	7.86	7.818	7.754	7.166	6.365	7.43	7.428
31-May	ORnurserySTD_Pre2020_mod_+60 ,	8.91	8.888	8.827	8.775	8.71	8.086	7.182	8.348	8.345
30-Jun	ORnurserySTD_Pre2020_mod_+90 ,	9.586	9.556	9.516	9.442	9.331	8.675	7.694	8.911	8.908
30-Jul	ORnurserySTD_Pre2020_mod_+120 ,	9.318	9.289	9.203	9.142	9.055	8.468	7.49	8.738	8.732
29-Aug	ORnurserySTD_Pre2020_mod_+150 ,	9.412	9.383	9.266	9.177	9.103	8.322	7.151	8.843	8.817
28-Sep	ORnurserySTD_Pre2020_mod_+180 ,	9.642	9.642	9.703	9.794	9.681	8.512	7.103	9.394	9.32
28-Oct	ORnurserySTD_Pre2020_mod_+210 ,	10.77	10.76	10.8	10.83	10.36	9.435	7.912	10.22	10.11
1-Apr	TNnurserySTD_Pre2020_mod_+0 ,	9.901	9.87	9.707	9.481	9.364	8.137	6.722	8.952	8.753
1-May	TNnurserySTD_Pre2020_mod_+30 ,	9.016	8.972	8.768	8.563	8.396	7.303	6.226	8.001	7.71
31-May	TNnurserySTD_Pre2020_mod_+60 ,	8.304	8.266	8.096	7.88	7.757	6.949	5.923	7.47	7.324
30-Jun	TNnurserySTD_Pre2020_mod_+90 ,	9.124	9.084	8.934	8.741	8.573	7.575	6.342	8.393	7.951
30-Jul	TNnurserySTD_Pre2020_mod_+120 ,	9.461	9.414	9.254	8.917	8.728	7.704	6.49	8.305	8.155
29-Aug	TNnurserySTD_Pre2020_mod_+150 ,	14.7	14.68	14.44	14.1	14.04	12.14	8.58	13.73	13.74
28-Sep	TNnurserySTD_Pre2020_mod_+180 ,	10.63	10.59	10.51	10.52	10.36	8.977	7.753	9.802	9.745
28-Oct	TNnurserySTD_Pre2020_mod_+210 ,	11.02	11.01	10.85	10.55	10.4	9.396	7.507	9.875	9.812
	Max EEC	***14.70***	*14.68*	***14.44***	***14.10***	*14.04*	***13.31***	***11.07***	*13.73*	*13.74*

PWC Turf EEC Output Summary File (Combined Results of Separate FL Turf and PA Turf Runs)

1st Date	Scenario Name	1-d	4-d	21-d	60-d	90-d	365-d	Full	1-db	21-db
17-Mar	FLturfSTD_Pre2020_mod_+0 ,	7.567	7.537	7.421	7.213	7.161	5.98	4.367	6.47	6.466
16-Apr	FLturfSTD_Pre2020_mod_+30 ,	8.396	8.343	8.096	7.713	7.536	6.502	4.268	6.941	6.944
16-May	FLturfSTD_Pre2020_mod_+60 ,	7.556	7.517	7.382	7.129	6.902	5.679	4.254	6.154	6.141
15-Jun	FLturfSTD_Pre2020_mod_+90 ,	6.068	6.029	5.869	5.586	5.431	4.628	3.905	4.998	5.012
15-Jul	FLturfSTD_Pre2020_mod_+120 ,	6.195	6.166	6.066	5.909	5.914	5.152	4.065	5.624	5.642
14-Aug	FLturfSTD_Pre2020_mod_+150 ,	7.869	7.81	7.602	7.316	7.09	5.895	4.874	6.37	6.377
13-Sep	FLturfSTD_Pre2020_mod_+180 ,	7.77	7.721	7.531	7.304	7.149	5.899	4.994	6.458	6.465
15-Apr	PAturfSTD_Pre2020_mod_+0 ,	7.999	7.971	7.853	7.609	7.471	6.586	5.696	6.963	6.959
15-May	PAturfSTD_Pre2020_mod_+30 ,	8.455	8.421	8.278	7.982	7.807	7.105	5.972	7.376	7.373
14-Jun	PAturfSTD_Pre2020_mod_+60 ,	10.42	10.37	10.14	9.731	9.512	8.807	6.549	9.107	9.136
14-Jul	PAturfSTD_Pre2020_mod_+90 ,	8.438	8.409	8.276	8.051	7.982	7.423	6.186	7.776	7.786
13-Aug	PAturfSTD_Pre2020_mod_+120 ,	9.13	9.1	8.948	8.74	8.647	8.146	6.481	8.352	8.324
12-Sep	PAturfSTD_Pre2020_mod_+150 ,	11.94	11.9	11.69	11.44	11.37	10.26	7.447	10.76	10.75
12-Oct	PAturfSTD_Pre2020_mod_+180 ,	12.66	12.61	12.36	11.98	11.91	10.55	7.598	11.08	11.06
	Max EEC	***12.66***	*12.61*	***12.36***	***11.98***	*11.91*	*10.55*	*7.598*	***11.08***	***11.06***

Appendix G. Output Tables for T-REX Terrestrial Modeling

Upper Bound Kenaga Residues for RQ Calculation

Chemical Name:	Cyclobutrifluram	
Use	Turf	
Formulation	A22011 T&O (SC)	
Application Rate	0.22	lbs a.i./acre
Half-life	35	days
Application Interval	14	days
Maximum # Apps./Year	2	
Length of Simulation	1	year
Variable application rates?	no	

Endpoints			
Avian	Bobwhite quail	LD50 (mg/kg-bw)	>2000
	Mallard duck	LC50 (mg/kg-diet)	>5245
	Bobwhite quail	NOAEL(mg/kg-bw)	
	Bobwhite quail	NOAEC (mg/kg-diet)	1899
Mammals	LD50 (mg/kg-bw)		>5000
	LC50 (mg/kg-diet)		
	NOAEL (mg/kg-bw)		43.1
	NOAEC (mg/kg-diet)		862

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	92.81
Tall Grass	42.54
Broadleaf plants	52.21
Fruits/pods/seeds	5.80
Arthropods	36.35

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	22.78	114	2.28E-02
Mid	100	13	64.94	65	6.49E-02
Large	1000	58	290.77	29	2.91E-01
Granivores	20	5	5.062	25	5.06E-03
	100	13	14.432	14	1.44E-02
	1000	58	64.615	6	6.46E-02

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	#VALUE!
100	#VALUE!
1000	#VALUE!

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	small 20	mid 100	large 1000
Short Grass	105.71	60.28	26.99
Tall Grass	48.45	27.63	12.37
Broadleaf plants	59.46	33.91	15.18
Fruits/pods	6.61	3.77	1.69
Arthropods	41.40	23.61	10.57
Seeds	1.47	0.84	0.37

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	#VALUE!	#VALUE!	#VALUE!
Tall Grass	#VALUE!	#VALUE!	#VALUE!
Broadleaf plants	#VALUE!	#VALUE!	#VALUE!
Fruits/pods	#VALUE!	#VALUE!	#VALUE!
Arthropods	#VALUE!	#VALUE!	#VALUE!
Seeds	#VALUE!	#VALUE!	#VALUE!

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	#VALUE!	0.05
Tall Grass	#VALUE!	0.02
Broadleaf plants	#VALUE!	0.03
Fruits/pods/seeds	#VALUE!	0.00
Arthropods	#VALUE!	0.02

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	0.014
	35	5	23	66	0.023
	1000	31	153	15	0.153
Granivores	15	3	3	21	0.003
	35	5	5	15	0.005
	1000	31	34	3	0.034

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	#VALUE!	94.73
	35	#VALUE!	76.64
	1000	#VALUE!	33.15
Granivores	15	#VALUE!	94.73
	35	#VALUE!	76.64
	1000	#VALUE!	33.15

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams)		
	15	35	1000
Short Grass	88.49	61.16	14.18
Tall Grass	40.56	28.03	6.50
Broadleaf plants	49.78	34.40	7.98
Fruits/pods	5.53	3.82	0.89
Arthropods	34.66	23.95	5.55
Seeds	1.23	0.85	0.20

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	#VALUE!	0.93	#VALUE!	0.80	#VALUE!	0.43
Tall Grass	#VALUE!	0.43	#VALUE!	0.37	#VALUE!	0.20
Broadleaf plants	#VALUE!	0.53	#VALUE!	0.45	#VALUE!	0.24
Fruits/pods	#VALUE!	0.06	#VALUE!	0.05	#VALUE!	0.03
Arthropods	#VALUE!	0.37	#VALUE!	0.31	#VALUE!	0.17
Seeds	#VALUE!	0.01	#VALUE!	0.01	#VALUE!	0.01

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	0.11
Tall Grass	#DIV/0!	0.05
Broadleaf plants	#DIV/0!	0.06
Fruits/pods/seeds	#DIV/0!	0.01
Arthropods	#DIV/0!	0.04

Appendix H. Output Tables for Terrestrial Vertebrate Analysis for KABAM

Cyclobutrifluram residues in aquatic food items for terrestrial vertebrates are based on maximum soil applications, 0.187 lb a.i./A, to ornamentals based on the MI Nursery scenario.

Table 1. Chemical characteristics of Cyclobutrifluram.		
Characteristic	**Value**	**Comments/Guidance**
Pesticide Name	**Cyclobutrifluram**	**Required input**
Log K_{OW}	**3.2**	**Required input** Enter value from acceptable or supplemental study submitted by registrant or available in scientific literature.
K_{OW}	**1585**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
K_{OC} (L/kg OC)	**410**	**Required input** Input value used in PRZM/EXAMS to derive EECs. Follow input parameter guidance for deriving this parameter value (USEPA 2002).
Time to steady state (T_S; days)	**3**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
Pore water EEC (µg/L)	**13.73**	**Required input** Enter value generated by PRZM/EXAMS benthic file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the pore water of the sediment. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. Select the EEC generated by PRZM/EXAMS which has an averaging period closest to the time to steady state calculated above. In cases where the time to steady state exceeds 365 days, the user should select the EEC representing the average of yearly averages. The peak EEC should not be used.
Water Column EEC (µg/L)	**14.69**	**Required input** Enter value generated by PRZM/EXAMS water column file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the water column. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. The averaging period used for the water column EEC should be the same as the one selected for the pore water EEC (discussed above).

Table 11. Estimated concentrations of Cyclobutrifluram in ecosystem components.				
Ecosystem Component	**Total concentration (µg/kg-ww)**	**Lipid normalized concentration (µg/kg-lipid)**	**Contribution due to diet (µg/kg-ww)**	**Contribution due to respiration (µg/kg-ww)**
Water (total)*	15	N/A	N/A	N/A
Water (freely dissolved)*	15	N/A	N/A	N/A
Sediment (pore water)*	14	N/A	N/A	N/A
Sediment (in solid)**	225	N/A	N/A	N/A
Phytoplankton	1,101	55042	N/A	1,100.85
Zooplankton	809	26970	0.45	808.65
Benthic Invertebrates	879	29296	1.26	877.61
Filter Feeders	583	29140	0.82	581.98
Small Fish	1,130	28244	4.86	1,124.91
Medium Fish	1,133	28334	9.15	1,124.21
Large Fish	1,143	28580	16.36	1,126.85
* Units: µg/L; **Units: µg/kg-dw				

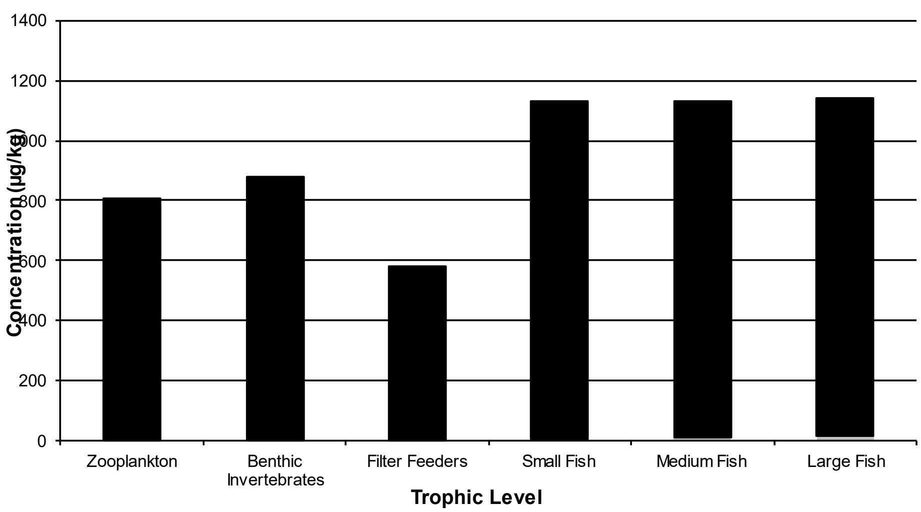


Figure 1. Total pesticide concentration per trophic level

Table 12. Total BCF and BAF values of Cyclobutrifluram in aquatic trophic levels.		
Trophic Level	Total BCF (µg/kg-ww)/(µg/L)	Total BAF (µg/kg-ww)/(µg/L)
Phytoplankton	77	75
Zooplankton	55	55
Benthic Invertebrates	60	60
Filter Feeders	40	40
Small Fish	77	77
Medium Fish	77	77
Large Fish	77	78

Table 13. Lipid-normalized BCF, BAF, BMF and BSAF values of Cyclobutrifluram in aquatic trophic levels.				
Trophic Level	BCF (µg/kg-lipid)/(µg/L)	BAF (µg/kg-lipid)/(µg/L)	BMF (µg/kg-lipid)/(µg/kg-lipid)	BSAF (µg/kg-lipid)/(µg/kg-OC)
Phytoplankton	3849	3747	N/A	10
Zooplankton	1835	1836	0.49	5
Benthic Invertebrates	1992	1994	1.08	5
Filter Feeders	1981	1984	1.08	5
Small Fish	1916	1923	1.00	5
Medium Fish	1916	1929	0.98	5
Large Fish	1922	1946	1.01	5

Table 14. Calculation of EECs for mammals and birds consuming fish contaminated by Cyclobutrifluram.						
Wildlife Species	Biological Parameters				EECs (pesticide intake)	
	Body Weight (kg)	Dry Food Ingestion Rate (kg-dry food/kg-bw/day)	Wet Food Ingestion Rate (kg-wet food/kg-bw/day)	Drinking Water Intake (L/d)	Dose Based (mg/kg-bw/d)	Dietary Based (ppm)
Mammalian						
fog/water shrew	0.02	0.140	0.585	0.003	0.516	0.88
rice rat/star-nosed mole	0.1	0.107	0.484	0.011	0.420	0.86
small mink	0.5	0.079	0.293	0.048	0.334	1.13
large mink	1.8	0.062	0.229	0.168	0.261	1.13
small river otter	5.0	0.052	0.191	0.421	0.218	1.13

large river otter	15.0	0.042	0.157	1.133	0.181	1.14
Avian						
sandpipers	0.0	0.228	1.034	0.004	0.8989	0.87
cranes	6.7	0.030	0.136	0.211	0.1184	0.87
rails	0.1	0.147	0.577	0.010	0.5819	1.00
herons	2.9	0.040	0.157	0.120	0.1590	1.01
small osprey	1.3	0.054	0.199	0.069	0.2268	1.13
white pelican	7.5	0.029	0.107	0.228	0.1224	1.14

Table 15. Calculation of toxicity values for mammals and birds consuming fish contaminated by Cyclobutrifluram.

Wildlife Species	Toxicity Values			
	Acute		Chronic	
	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)
Mammalian				
fog/water shrew	#VALUE!	0.00	90.51	862
rice rat/star-nosed mole	#VALUE!	0.00	61.40	862
small mink	#VALUE!	0.00	40.48	862
large mink	#VALUE!	0.00	28.62	862
small river otter	#VALUE!	0.00	22.17	862
large river otter	#VALUE!	0.00	16.85	862
Avian				
sandpipers	#VALUE!	>5245	N/A	1899
cranes	#VALUE!	>5245	N/A	1899
rails	#VALUE!	>5245	N/A	1899
herons	#VALUE!	>5245	N/A	1899
small osprey	#VALUE!	>5245	N/A	1899
white pelican	#VALUE!	>5245	N/A	1899

Table 16. Calculation of RQ values for mammals and birds consuming fish contaminated by Cyclobutrifluram.				
Wildlife Species	**Acute**		**Chronic**	
	Dose Based	**Dietary Based**	**Dose Based**	**Dietary Based**
Mammalian				
fog/water shrew	#VALUE!	#DIV/0!	0.006	0.001
rice rat/star-nosed mole	#VALUE!	#DIV/0!	0.007	0.001
small mink	#VALUE!	#DIV/0!	0.008	0.001
large mink	#VALUE!	#DIV/0!	0.009	0.001
small river otter	#VALUE!	#DIV/0!	0.010	0.001
large river otter	#VALUE!	#DIV/0!	0.011	0.001
Avian				
sandpipers	#VALUE!	#VALUE!	N/A	0.000
cranes	#VALUE!	#VALUE!	N/A	0.000
rails	#VALUE!	#VALUE!	N/A	0.001
herons	#VALUE!	#VALUE!	N/A	0.001
small osprey	#VALUE!	#VALUE!	N/A	0.001
white pelican	#VALUE!	#VALUE!	N/A	0.001