Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE

Expanded Spotted Lanternfly Control Program in Select States in the Midwest, Northeast, and Mid-Atlantic Regions of the United States

Final Environmental Assessment, April 2023

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I. Introduction

A. Background

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) is considering actions that will assist with control and treatment of spotted lanternfly (SLF), *Lycorma delicatula*, to slow the spread of this invasive insect. SLF is a planthopper (family Fulgoridae, order Hemiptera) that is native to Asia. The insect was first detected in the United States in 2014 in Pennsylvania. SLF nymphs are generalists and feed on a wide range of plants (Dara et al. 2015; USDA APHIS 2014), while SLF adults prefer tree-of-heaven, *Ailanthus altissima*, also known as stinking or Chinese sumac, for feeding, overwintering, as well as egg laying. Adult SLF will also feed on grapevines (*Vitis vinifera*), stone fruits (almond, apricot, cherry, nectarine, peach, and plum), other fruit trees (e.g., apple, pear, walnut, and chestnut), and other trees (maple, oak, pine, poplar, and willow) (see Appendix B for a list of hosts). If allowed to spread, APHIS is concerned that SLF could prove harmful to grape, tree fruit, stone fruit, maple syrup, tree nursery, and logging industries throughout the United States.

Adult SLF are approximately one inch long and one-half inch wide, appear in mid to late July, and have large and visually striking wings (Figure 1 and Figure 2). Their forewings are light brown with black spots at the front and a speckled band at the rear. Their hind wings are scarlet with black spots at the front and white and black bars at the rear. Their abdomen is yellow with black bars. Nymphs in their early stages of development appear black with white spots and turn to a red phase before becoming adults (Dara et al. 2015; PDA 2022c).

Figure 1. Adult spotted lanternfly.

Figure 2. Adult spotted lanternfly with wings spread.

Adult SLF lay their eggs on smooth host plant surfaces and on non-host material, such as bricks, stones, and dead plants. Egg masses are yellowish-brown in color and covered with a gray, waxy coating prior to hatching. Eggs hatch in the spring and early summer. Egg masses can easily be transported long distances on a wide variety of non-food commodities such as rocks, concrete, tile, and wood. SLF can walk, jump, or fly short distances, and its long-distance spread is facilitated by people who move infested material or items containing SLF (eggs, nymphs, and adults) (Dara et al. 2015; PDA 2021).

Both nymphs and adult SLF damage host plants when they feed by sucking sap from stems and leaves. This reduces photosynthesis, causes plant stress, and eventually may contribute to the plant's death. SLF feeding can cause the plant to ooze or weep down the exterior of the tree (Dara et al. 2015) and the insects themselves excrete large amounts of fluid (honeydew). The sap and other fluids promote mold and fungi growth and attract other insects (PDA 2022c). APHIS does not have data on the level of tree mortality SLF may cause over time; however, stress from attack by SLF could predispose native host trees and other plants to additional pests and pathogens.

Wakie et al. (2020), assessed the risk of SLF becoming established in the U.S. using the ecological niche model MAXENT. Wakie et al. predicted that SLF can become established in most of New England and the Mid-Atlantic states, as well as the central United States and the Pacific Coast states. See figure 3 below. Areas shaded in orange, yellow, and green indicate high, medium, and low suitability, respectively. Unshaded/blank areas indicate areas that are unsuitable for SLF establishment.

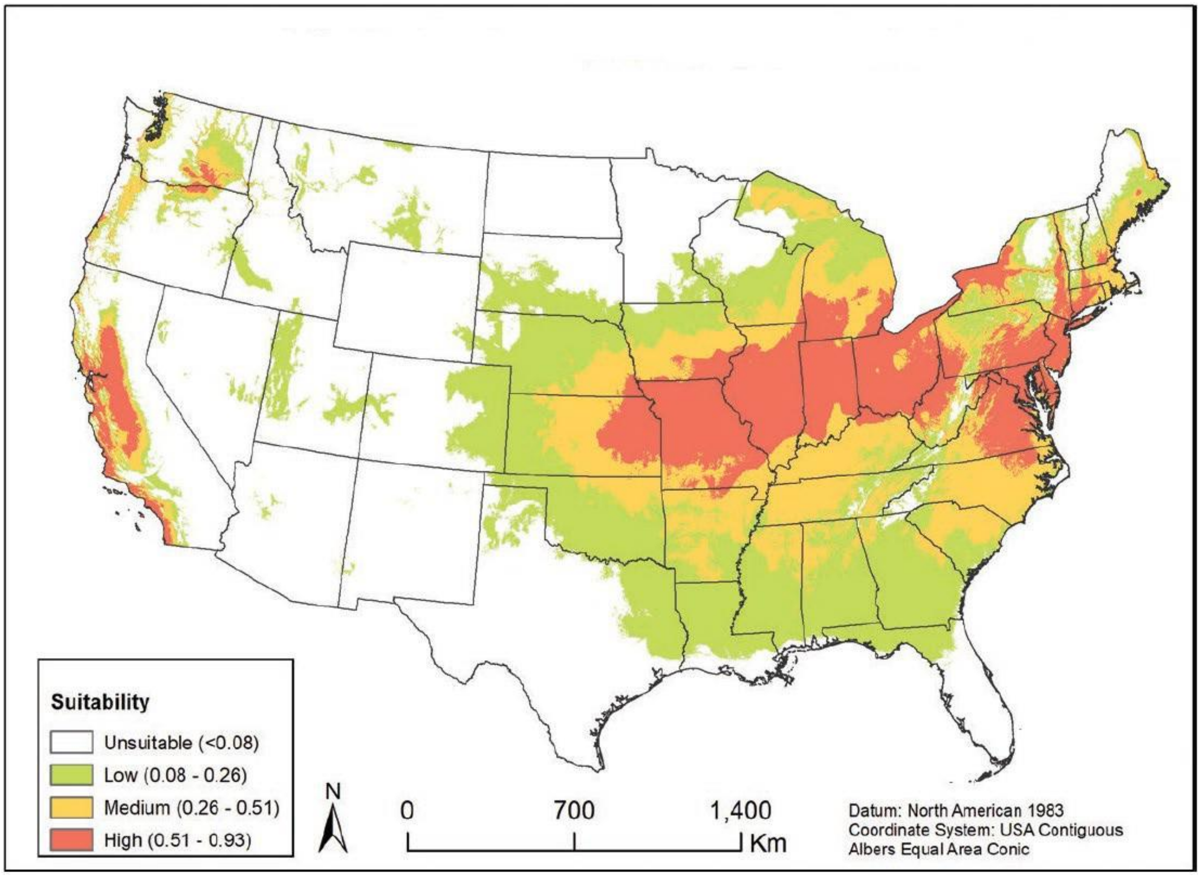

Figure 3. Potential distribution of SLF in the United States

Source: (Wakie et al. 2020)

Pest damage leading to changes in forest composition is well-characterized (McGarvey et al. 2015; Mikkelson et al. 2013). Impacts in Pennsylvania from SLF have been considered significant by the state with SLF potentially devastating agriculture and forestry industries (Harper et al. 2019). A 2019 study in Pennsylvania estimates that direct impacts of SLF damage statewide could amount to $42.6 million (Harper et al. 2019). Estimates were based on USDA's 2017 crop market values and surveys of crop production experts. Researchers indicate limited information on crop specific SLF damage. For example, it is difficult to distinguish the cause of or relative contribution of losses, as in the case of winter injury and SLF feeding on grapes; therefore, estimates are "unrefined" and subject to revisions as new information becomes available.

Significant damage from SLF has been reported specifically on grapevines. SLF feeding on grapevines can result in increased susceptibility to winter injury, failure of vines to set fruit in the subsequent year, and death of vines (Leach et al. 2021). However, SLF is a highly mobile pest, with nymphs and adults unlikely to be associated with commodities that are produced and moved for sale, and international and domestic trade impacts are expected to be minimal, except for the impacts from the implementation of local quarantines (USDA APHIS 2014).

B. Purpose and Need

APHIS has the responsibility to take actions that exclude, eradicate, and control plant pests under the Plant Protection Act of 2000 (7 United States Code (USC) 7701 et seq.). Due to the potential effects of SLF to agriculture and forest host plants, the goal of the SLF Control Program is to increase APHIS' and their cooperator's preparedness by having a combination of control actions available for deployment when and where SLF populations may occur.

Despite previous control efforts, the population of SLF continues to spread (Figure 4). In February 2023 the SLF Program proposed to add the states of Indiana, Massachusetts, Michigan, and Rhode Island to the potential program area and modify some Program treatments. (From this point forward in the EA, the SLF Control Program may be referred to as SLF Program or simply Program.)

This EA was prepared consistent with the National Environmental Policy Act of 1969 (NEPA), 2020 NEPA updates, and the APHIS NEPA implementing procedures (7 Code of Federal Regulations (CFR) part 372) for the purpose of evaluating how the proposed action (the Preferred Alternative), if implemented, may affect the quality of the human environment. The proposed action does not meet the criteria for actions normally requiring environmental impact statement (7 CFR § 372.5(a)) based on the lack of significant impacts to the human environment associated with the as-needed deployment of Program control actions.

Notice of the availability of a draft version of this EA was published in newspapers within each state to facilitate review and input to the EA from the public. The draft EA was available at *regulations.gov* (docket # APHIS-2023-0004) on 15 February 2023; the public comment period ended on 3 April 2023. APHIS received three comments for the EA and, after consideration, added mention to this final EA of the U.S. maple industry as another entity potentially affected by SLF infestation in North America. The comments are addressed in the Finding of No Significant Impact and Decision for this EA

C. Previous SLF Program Environmental Assessments (EAs)

APHIS published the first SLF Program environmental assessment (EA) in 2015 with the detection of SLF in Pennsylvania. As additional control options became available and new SLF detections expanded the treatment area, the Agency published additional EAs, supplemental EAs, and their related decision documents referred to as Finding of No Significant Impact (FONSI). Since the publication of the last EA in October 2021, SLF has been confirmed in Indiana, Massachusetts, Michigan, and Rhode Island. Implementation of the Preferred Alternative in this Final EA will add these four states to the Program treatment area, modify the use pattern for ground-based mist blower and high-pressure hydraulic spray applications for the insecticides bifenthrin and beta-cyfluthrin, and add the use of high-pressure water to remove egg masses from *Ailanthus* trees and inanimate objects and equipment.

This EA incorporates the six prior SLF Program EAs, supplemental EAs, and their FONSIs by reference.[1] Below is a short, general summary of the prior EAs APHIS published since 2015. Table 1 summarizes the Program's control measures and their inception into the Program.

May 2015 "Spotted Lanternfly Eradication Program in Berks, Lehigh, and Montgomery Counties, Pennsylvania Environmental Assessment"

This was the first EA APHIS prepared for the SLF Program. The EA described the Program's eradication activities in Berks, Lehigh, and Montgomery Counties, Pennsylvania and expanded to include Bucks and Chester Counties. Eradication activities include:

- Regulatory control - consists of a state quarantine established to eliminate intrastate and interstate movement and reduce human-assisted spread of SLF. High-risk host material from within the quarantine area would be prohibited from moving outside of the area, except under a permit issued by the appropriate department of agriculture.

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[1] All available @ https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/ea/ct_slf.

- Survey/Egg mass scraping – Detection survey uses visual inspection and sweep netting to determine if SLF is present. Egg mass scraping consists of scraping egg masses from plants with a stiff plastic card into bags with an alcohol solution to cause mortality.
- Sanitation – Sanitation of all other green waste within a quarter mile of SLF detections that may include chipping or grinding the debris, and disposal through incineration or burning.
- Tree banding – self-adhesive paper bands around tree-of-heaven trees from SLF hatch in May to death of the adult population in November to capture SLF while they move up the trunk or congregate to feed and mate. Volunteers or program personnel will replace tree bands on a bi-weekly basis and report the number of SLF captured to develop data on the infestation and control achieved. Used bands are bagged and placed in a landfill.
- Tree removal – the invasive species, tree-of-heaven (*A. altissima*), will be removed up to a quarter-mile radius from infested trees. Herbicide treatment of the stumps will be used during periods of the year when the phloem moves towards the root. The herbicide triclopyr will be applied on stumps, and foliar applications of glyphosate will be made to re-sprouts from stumps.
- Insecticide applications – insecticide treatments for select tree-of-heaven trees will be made using ground equipment by certified applicators. Dinotefuran is an insecticide for SLF eradication and will be used by the Program in conjunction with tree removal and banding, the two other primary non-chemical treatment options. Dinotefuran is applied through a basal trunk spray to a small number of trap trees (about 10 trees at a given site) that serve to attract and kill SLF. Three other insecticide products, bifenthrin, pymetrozine, and *Beauveria bassiana* strain GHA, will only be used in small experimental plots to help APHIS evaluate the efficacy of each in controlling SLF. Experimental treatments will only occur on private properties inside an active quarantine area, and only with landowner permission.

March 2018 “Spotted Lanternfly Eradication Program in Select Counties in Pennsylvania Supplemental Environmental Assessment”

The Program’s area expanded to include Carbon, Delaware, Lancaster, Lebanon, Monroe, Northampton, Philadelphia, and Schuylkill Counties in Pennsylvania.

The Program’s eradication activities remain as outlined in the 2015 EA but adds the insecticide imidacloprid applied through trunk injection to trap trees and three additional herbicides, imazapyr, metsulfuron-methyl and aminopyralid, to treat remaining stumps and associated sprouts applied by hand painting the stump or directly spraying the stumps and/or sprouting foliage using a backpack sprayer.

March 2018 “Spotted Lanternfly Eradication Program in Frederick County, Virginia”

The Program continues the eradication activities described in previous EAs and adds Frederick

County, Virginia to the Program area.

May 2018 “Spotted Lanternfly Control Program in the Mid-Atlantic Region”

In this EA, the Program considers programmatic control efforts through the Mid-Atlantic states including Connecticut, Delaware, Maryland, New York, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia, and District of Columbia. Some of these states were covered in prior EAs. The control activities are the same as described in the prior EAs. The Program changed from an eradication program to a control program. This EA does not mention the use of bifenthrin, pymetrozine, and *Beauveria bassiana* strain GHA, for use in small experimental plots to evaluate the efficacy of each in controlling SLF; the Program was not doing any additional experimental plot testing.

June 2020 “Spotted Lanternfly Control Program in the Mid-Atlantic Region, North Carolina, Ohio, and Kentucky

This EA expands treatment locations to include the states of Ohio and Kentucky. This EA also adds circle traps to its detection survey for SLF and five insecticides to the Program: bifenthrin, beta-cyfluthrin, *B. bassiana*, soybean oil, and dichlorvos. The use patterns for Program insecticides are as follows:

- dinotefuran or imidacloprid on trap trees (same use pattern as prior EAs);
- bifenthrin, beta-cyfluthrin, or *B. bassiana* on ornamental and *A. altissima* tree trunks in commercial and residential areas, perimeter areas and surfaces in and around train yards, airports, seaports, trucking depots, railways, and powerline easements
- soybean oil on SLF eggs attached to various surfaces including trees, ground litter, firewood, nursery stock, rocks, vehicles, or on other articles moved in interstate commerce; and,
- dichlorvos (DDVP) strips placed within circle traps attached to tree trunks.

The Program moves from cutting and felling *A. altissima* trees located within a ¼-mile radius of a SLF find to using herbicides to remove trees. The Program may manually remove dying *A. altissima* trees if they are a fall hazard.

October 2021 “Spotted Lanternfly Control program in the Mid-Atlantic Region, North Carolina, Ohio, and Kentucky” Supplemental EA

Despite Program control efforts, the population of SLF continues to spread. The Program determined that rail lines and intermodal areas are a high-risk pathway for long distance spread of SLF. In addition, recently hatched SLF nymphs can climb to a height of more than 5 meters (16.5 feet) within trees (Kim et al. 2011) warranting new application methods. Chemical application types previously considered include hand-held backpack and truck-mounted sprays (also referred to as high-pressure hydraulic sprays) that cannot reach these heights. In this EA, APHIS considers the option to use ground-based mist blowers to treat SLF nymphs and adults in certain locations. Mist blowers are sprayers that use a fan to blow insecticide emitted through nozzles into a directed mist. They are useful for the treatment of large areas and applying insecticide into areas of dense foliage where SLF is present. This EA adds ground-based mist blowers as an application method for bifenthrin and beta-cyfluthrin and expands the use sites for these two insecticides to include railways, train yards, and intermodal rail terminals. However, the use of mist blowers is geographically restricted to the following:

- Maryland - Alleghany, Frederick, and Washington county.
- Ohio - Belmont, Carroll, Columbiana, Harrison, and Jefferson County.
- Pennsylvania - statewide.
- Virginia - Albemarle, Augusta, Bath, Clarke, Frederick, Highland, Loudoun, Nelson, Page, Rockbridge, Rockingham, Shenandoah, and Warren County.
- West Virginia - Berkeley, Brooke, Hancock, Jefferson, Morgan, and Ohio county.

Table 1 shows SLF program activities in relation to the Environmental Assessment (EA) publication dates starting May 2015 to the current EA. Figure 4 shows the area the Program analyzed over time.

Table 1. Summary of SLF Program control activities since the Program’s inception in 2015.

Program Activity	May 2015	March 2018[1]	May 2018	June 2020	October 2021	Current EA
State quarantine	X	X	X	X	X	X
Survey/egg mass scraping	X	X	X	X	X	X
High pressure water spray	--	--	--	--	--	X
Sanitation	X	X	X	X	X	X
Tree banding	X	X	X	X	X	X
Circle traps	--	--	--	X	X	X
Tree removal (manual)	X	X	X	X	X	X
Tree removal with herbicides	--	--	--	X	X	X
Herbicides	**May 2015**	**March 2018[1]**	**May 2018**	**June 2020**	**Oct. 2021**	**Current EA**
Triclopyr	X	X	X	X	X	X
Glyphosate	X	X	X	X	X	X
Imazapyr	--	X	X	X	X	X
Metsulfuron-methyl	--	X	X	X	X	X
Aminopyralid	--	X	X	X	X	X
Insecticides	**May 2015**	**March 2018[1]**	**May 2018**	**June 2020**	**Oct. 2021**	**Current EA**
Dinotefuran	X	X	X	X	X	X
Imidacloprid	--	X	X	X	X	X
Bifenthrin	*Exp.*	*Exp.*	--	X[2]	X[2&3]	X[4]
Pymetrozine	*Exp.*	*Exp.*	--	--	--	--
Beta-cyfluthrin	--	--	--	X[2]	X[2&3]	X[4]
Beauveria bassiana strain GHA	*Exp.*	*Exp.*	--	X	X	X
Soybean oil	--	--	--	X	X	X
Dichlorvos (circle traps)	--	--	--	X	X	X

Exp. = Experimental

1 APHIS published two environmental assessments in March 2018.

2 Includes high-pressure hydraulic sprayer (truck- or ATV-mounted) applications (hydraulic sprayer same as truck mounted).

3 Includes the use of ground-based mist blowers, which are limited to select counties within the Program area to treat SLF at railways, train yards, and intermodal rail terminals.

4 Includes the use of ground-based mist blowers and high-pressure hydraulic spray treatments that may occur along rail and road rights-of-way throughout the Program area.

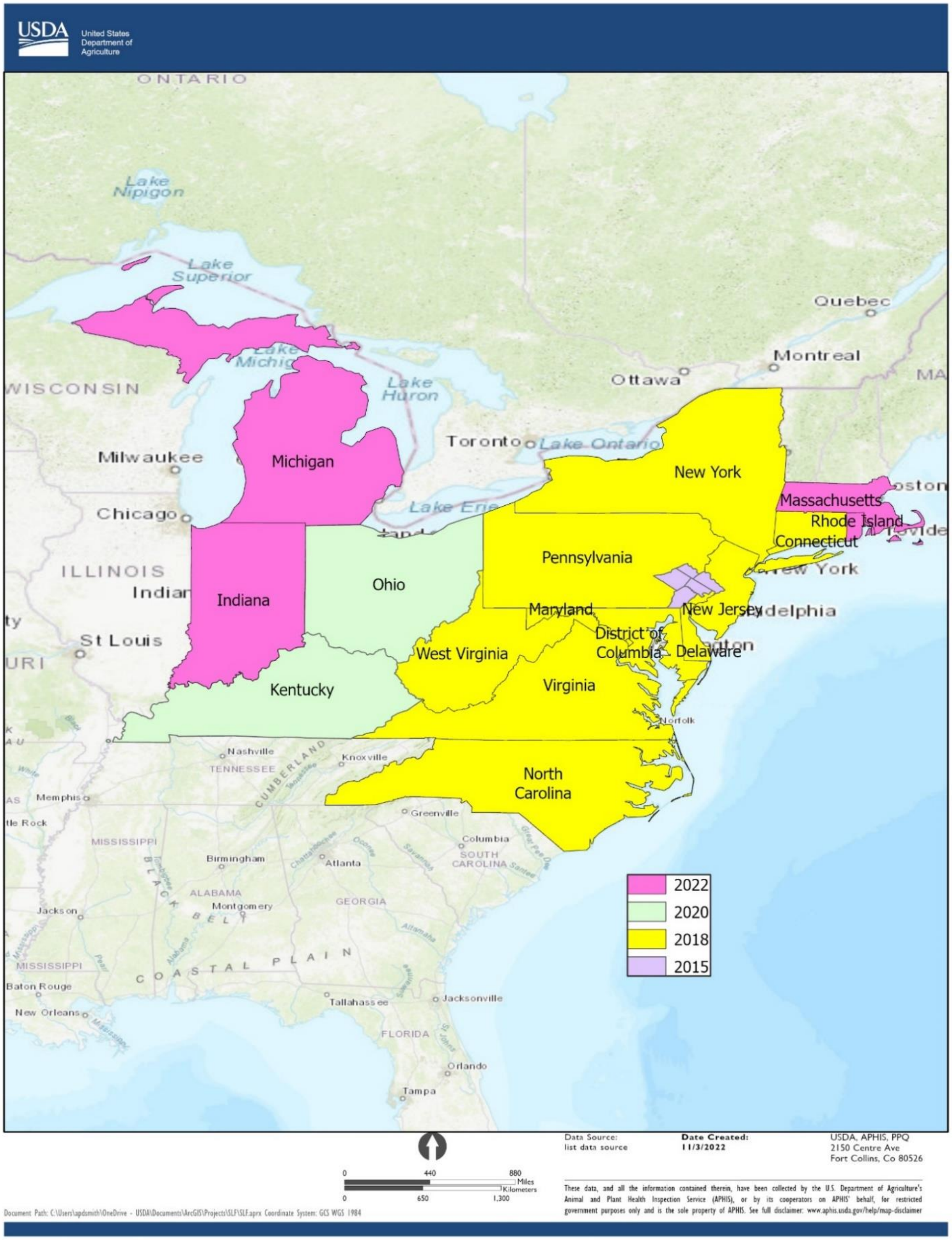

Figure 4. Map of the SLF Program areas analyzed in USDA APHIS environmental assessments since 2015.

II. Alternatives

Three alternatives for the SLF Program are outlined and compared below. The preferred alternative expands the SLF program area, modifies the use pattern for mist blower and high-pressure hydraulic spray applications, and adds a new treatment, high-pressure water for egg mass removal. The no treatment alternative withdraws APHIS involvement in SLF control. The no action alterative keeps the Program as described in the October 2021 EA; the Program would not expand to include the states of Indiana, Massachusetts, Michigan, and Rhode Island, and current treatment strategies and use sites would not change.

A. Preferred Alternative

Under the preferred alternative, APHIS would expand the SLF Program to include Indiana, Massachusetts, Michigan, and Rhode Island. The control measures under this preferred alternative are the same as the control measures described under the preferred alternative in the October 2021 supplemental EA "Spotted Lanternfly Control Program in the Mid-Atlantic Region, North Carolina, Ohio, and Kentucky"[2] with three modifications: 1) This EA expands the use of ground-based mist blowers and high-pressure hydraulic spray treatments of bifenthrin and beta-cyfluthrin to road rights-of-way in addition to railways, train yards, and intermodal rail terminals that were covered in the 2021 EA; 2) the use of mist blowers and high-pressure hydraulic spray treatments could occur along rail rights-of-way without the geographical restrictions imposed in the 2021 EA where applications were limited to rail rights-of-way within select counties in the Program area; and 3) the addition of high-pressure water treatment to remove egg masses from *Ailanthus* trees and inanimate objects and equipment.

The SLF Program uses a combination of control methods, based upon site-specific requirements that consider program efficacy and environmental considerations. Control efforts may include any or all the following: regulatory control (quarantines), surveys, egg mass scraping, high-pressure water egg removal, sanitation, herbicide treatments to *A. altissima* trees and removal of *A. altissima* trees that are a fall hazard, tree banding/circle traps, trap trees, and insecticide applications.

1. Regulatory Control

Regulatory control consists of a state quarantine established to eliminate intrastate and interstate movement and reduce human-assisted spread of SLF. SLF nymphs have a broad host range and will change hosts while going through developmental stages. They are stem and trunk feeders.

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[2] available @ https://www.aphis.usda.gov/plant_health/ea/downloads/2021/supplemental-slf-mid-atlantic-october-2021.pdf

Adults also feed on a wide range of plants. The host list for SLF includes, but is not limited to: *Juglans*, *Malus*, *Pinus*, *Populus*, *Prunus*, *Quercus*, and *Vitis* (see Appendix B for an expanded list of SLF host plants). Currently, there is no federal quarantine in place. States have imposed quarantines, listing regulated articles that are prohibited from moving outside of the quarantine area, except under a permit issued by the appropriate department of agriculture. Below is an example of Pennsylvania's Department of Agriculture list of regulated articles (PDA 2022b); other States' departments of agriculture that are within the SLF program area have the same or similar list of regulated articles:

- Any living life stage of the SLF.
- Brush, debris, bark, or yard waste.
- Landscaping, remodeling, or construction waste.
- Logs, stumps, or any tree parts.
- Firewood of any species.
- Packing materials, such as wood crates or boxes.
- All plants and plant parts. This shall include, but is not limited to, all live, dead, infected or non-infected trees, nursery stock, budwood, scionwood, green lumber, firewood, perennial plants, garden plants and produce and other material living, dead, cut, fallen including stumps, roots, branches, mulch, and composted and uncomposted chips.
- Outdoor household articles including recreational vehicles, lawn tractors and mowers, mower decks, grills, grill and furniture covers, tarps, mobile homes, tile, stone, deck boards, mobile fire pits, any associated equipment and trucks or vehicles not stored indoors.
- Grapevines for decorative purposes or as nursery stock.
- Any other article or means of conveyance when it is determined by an inspector to present a risk of spread of SLF in any life stage, is in proximity to such articles, the articles present a high risk of artificial spread, and the person in possession of them has been notified.

2. Detection Survey

Detection survey will use visual inspection to determine if SLF is present. Immature and adult SLF crawl up trees each day and can be observed visually. Tree bands and circle traps (discussed below) will also be used to detect infestations.

3. Egg Mass Scraping

The Program works with local agricultural extension offices to train local citizens to identify egg masses. To locate egg masses, from October through May, program personnel and volunteers identify locations that have feeding damage or presence of SLF on plants. Volunteers and program personnel will scrape egg masses from plants with a stiff plastic card.

4. High-Pressure Water Egg Mass Removal

High-pressure water will be used to remove egg masses from *Ailanthus* trees and inanimate objects and equipment. The machine is like a pressure washer and would be used from late fall to early spring when egg masses could be present and when temperatures are above freezing as to avoid icing issues. The machine is towed on a single axle cart (or similar) and the vehicle remains on established roads or pathways spraying egg masses from rail cars, cargo containers, structures, other inanimate objects.

5. Sanitation

Sanitation of green waste within ¼ mile of SLF detections may include chipping, grinding, incinerating, or burning the debris. Green waste is defined as debris from felled trees or other regulated material. Incineration would only occur at a licensed incineration facility. Burning of debris would only occur with the appropriate state and local permits. Steaming, composting, and burial of green waste are options under consideration for the future.

6. *Ailanthus altissima* Control

Contractors for cooperators will treat *A. altissima* trees that are within a ¼-mile radius from infested trees with an herbicide to kill it. *A. altissima* is a non-native, invasive tree that is a preferred host for the SLF. The Program applies triclopyr (triclopyr butoxyethyl ester (BEE), Garlon® 4 Ultra), imazapyr, or metsulfuron-methyl to stumps by hand painting, physical wounding the stump and injecting the herbicide, or spraying the stump using a backpack sprayer. Applications of triclopyr, imazapyr, or metsulfuron-methyl to small trees would be by injection into girdling wounds or spraying the base of the tree using a backpack sprayer. Herbicide applications usually occur June through September, although stump and trunk applications may occur during winter months. Foliar applications of glyphosate or aminopyralid would be made to re-sprouts from stumps outside of wetland areas from June through September. The killed trees will generally be left standing. The Program may manually remove *A. altissima* trees instead of treating trees with herbicides or remove dying trees that are a fall hazard. The Program follows the sanitation procedures described above when it removes living trees; if the tree is dead or dying, it may be felled and cut into logs and left in place or disposed of following the sanitation procedures described above.

7. Tree Bands and Circle Traps

SLF nymphs emerge from egg masses in late April to early May and pass through four nymphal stages. The nymphs crawl up and down trees to feed each day. Though the nymphs can be found on many types of plants, they strongly prefer *A. altissima* and banding these trees with an adhesive trap is effective in capturing the first three nymphal stages. Research from Korea indicates that brown colored adhesive bands are most effective. Traps are placed on SLF host trees that are at least six inches wide at chest height. The adhesive portion of the tree band is turned inward towards the tree trunk to avoid bycatch of other species. The SLF Program and its cooperators will use traps on *A. altissima* from the end of April/early May (when SLF hatch) to November (when adult SLF populations die) to capture SLF while they move up the trunk or congregate to feed and mate. Volunteers or program personnel will replace tree bands every two weeks and report the number of SLF captured to develop data on the infestation and control achieved. Used bands will be bagged and placed in a landfill.

Tree bands are only occasionally used and have for the most part been replaced with the circle trap. Circle traps are recommended over sticky traps because they are more effective at capturing SLF and are reusable (Francese et al. 2020). Circle traps are made of mesh wrapped around the trunk of *A. altissima* and other host trees. SLF crawl up the tree into a funnel of mesh, and the mesh funnels them into an enclosed container containing a vapor-releasing dichlorvos (DDVP) insecticide strip from which they cannot escape. Dichlorvos kills captive SLF. The Program does not allow volunteers to place circle traps because of the dichlorvos insecticidal strip; only program personnel place and service circle traps. Both the inward-facing tree bands and circle traps are designed to reduce by-catch (i.e., other insect and animal species that are caught unintentionally) relative to outward-facing sticky tree band traps. The Program's use of dichlorvos is discussed under the insecticide treatments section below.

8. Insecticide Treatments

The insecticides for Program use are the same as those described under the preferred alternative in the October 2021 supplemental EA titled "Spotted Lanternfly Control Program in the Mid-Atlantic Region, North Carolina, Ohio, and Kentucky Supplemental Environmental Assessment". Only licensed applicators or persons working under the supervision of a licensed applicator will apply insecticides. Application of insecticides on private land will occur only with landowner consent. Applicators will follow the product container Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) section 3 label instructions regarding the use of protective equipment, use limitations, dosage, entry restrictions and all other use directions, unless the use is approved under an alternate registration type, such as a FIFRA section 24(c) approval (see the U.S. Environmental Protection Agency (USEPA) website for additional information on section 24(c) at https://www.epa.gov/pesticide-registration/guidance-fifra-24c-registrations, last accessed October 13, 2022).

The Program has four types of insecticide treatments: 1) dinotefuran and imidacloprid applications to trap trees, 2) knock-down sprays using bifenthrin, beta-cyfluthrin, or *Beauveria bassiana*, 3) soybean oil treatment for egg masses, and 4) circle traps containing dichlorvos. Descriptions of these insecticide treatments follows and are summarized in Table 2 , Table 3., and Table 4.

Trap Trees (Dinotefuran, Imidacloprid)

Trap trees are live *A. altissima* trees, generally 6 inches or greater in diameter at breast height (dbh), left on a property after eliminating the other viable *A. altissima* trees with herbicides or manual removal. The Program would leave four to five clusters of trap trees, with each cluster containing approximately 10 or fewer trees, within the ¼-mile radius of the SLF infested area, from mid-May through August. The number of clusters can vary depending on the site where SLF is found. Removal of most *A. altissima* in an area means that when the late instar and adult SLF start searching for *A. altissima* to feed on, their only nearby option is one of the insecticide-treated trap trees.

Dinotefuran and imidacloprid are systemic neonicotinoid insecticides that are taken up by the root system, foliage, or through the bark and translocated upward throughout the plant. Their mode of action involves disruption of an insect's central nervous system by binding to the post-synaptic nicotinic acetylcholine receptors, thereby competing with the natural neurotransmitter acetylcholine (Simon-Delso et al. 2015). This long-lasting receptor binding has delayed lethal effects such that repeated or chronic exposure can lead to cumulative effects over time (Simon-Delso et al. 2015). Insects must feed on the treated plant to be exposed to a lethal dose, but the presence of the chemicals only within the plant simultaneously minimizes exposure of nontarget organisms.

The Program adheres to the insecticide’s label requirements, including allowable application rates, protective equipment, exclusion, and entry restrictions. Only licensed applicators or persons working under the supervision of a licensed applicator shall apply insecticides. Areas will be retreated at specified intervals based upon the label directions, persistence of the insecticide, and environmental conditions.

Dinotefuran or imidacloprid treatments will not occur when the tree bark is wet, during rainfall, or if rain is expected within 12 hours after application. Only one application of dinotefuran or imidacloprid will occur at a treatment site per year. The program will not apply insecticide when trees are dormant, under drought stress, or not actively taking up water from the soil. The program will also avoid application when trees are blooming to avoid harming beneficial insects such as bees. Trap trees will not occur in wetland areas.

The SLF program applies dinotefuran using a basal trunk spray or a trunk injection. The Program uses backpack sprayers, hydraulic spray treatments, or spray equipment with tanks mounted on ground vehicles to make basal trunk sprays. For basal trunk sprays, applicators spray bark on the root flare and over the entire circumference of the tree trunk between soil surface and 60 inches above the soil surface. The dosage used will be up to 1.62 pounds (lb) active ingredient (a.i.)/acre (ac) under a section 24(c) Special Local Needs (SLN) registration. Treatments will wet the bark just to the point of saturation and avoid runoff of the chemicals into adjacent soil. The applicators will use a low volume sprayer operated at 10 to 20 pounds per square inch and a spray nozzle that produces medium-sized droplets to prevent tree damage, bounce back, and drift. A surfactant may be added to the spray solution to improve surface wetting and bark penetration. For trunk injections, dinotefuran (Dinocide HP® or equivalent (12% dinotefuran)) is injected once per calendar year into *A. altissima* trees (no smaller than 2 inches in diameter) at the following dosage, depending on tree diameter:

- 1.0 mL per inch dbh for trees 2 to 10 inches dbh or 2 mL per injection site every 6 inches of circumference.
- 1.5 mL per inch dbh for trees 10 to 36 inches dbh or 3 mL per injection site every 6 inches of circumference.
- 2.0 mL per inch dbh for trees 36 inches dbh or 4 mL per injection site every 6 inches of circumference.

In the SLF program, an imidacloprid formulation such as Merit® 2F would be applied through trunk injection which is then translocated upward. Merit® 2F (21.4% imidacloprid a.i. and 78.6% inert ingredients) contains 2 lbs of imidacloprid per gallon (Bayer 2004). The rate of application for Merit® 2F is 3-6 ml (0.1-0.2 fl oz) per inch of trunk dbh. Applications would occur once a year.

Knock-down Sprays (Bifenthrin, Beta-cyfluthrin, *Beauveria bassiana*)

The goal of the knock-down spray is to reduce SLF populations in areas at higher risk of SLF spread through human-assisted movement, such as airports, seaports, trucking depots, train yards, and rail and road rights-of-way. The habit of SLF at certain periods in its lifecycle is to climb high structures. The Program may use two pyrethroid insecticides (bifenthrin and beta-cyfluthrin) and the entomopathogenic fungus *Beauveria bassiana* to treat SLF host trees and vegetation, as well as objects such as fences, light poles, buildings, or other structural elements that would be attractive to SLF. Knock-down sprays with these three contact insecticides will allow for effective treatments to kill egg-laying females in areas with a high likelihood of human assisted movement. In contrast, the treatment of trap trees with the systemic insecticides imidacloprid and dinotefuran (described above) is only efficacious when SLF are feeding; they must ingest the systemic insecticide for it to be effective.

The Program would apply bifenthrin, beta-cyfluthrin, or *Beauveria bassiana* according to product labels at the following use sites using high-pressure hydraulic spray treatment from a truck- or ATV-mounted tank (Figure 5), handheld tank sprayer, or backpack sprayer:

- on ornamental and *A. altissima* tree trunks in commercial and residential areas,
- perimeter areas and surfaces[3] in and around:
    - rail rights-of-way,
    - train yards,
    - airports,
    - seaports,
    - trucking depots (where trucks pick-up and deliver cargo; can include perimeter fences),
    - road rights-of-way, including public roads (e.g., highways, secondary roads), and
    - distribution centers (large warehouses where trucks unload cargo at a facility).

Figure 5. SLF insecticide treatments using pressurized equipment, and an example of spray tank and pump that is mounted onto a truck or ATV.

At these use sites, the bifenthrin product used is Talstar® P (7.9% a.i.) and the use rate is a 0.06% dilution. The Program would apply bifenthrin according to label instructions. The beta-cyfluthrin product used is Tempo® SC Ultra 11.8% at a rate of 0.05% (16 ml (0.54 fl oz) per gal water). The Program uses *Beauvaria bassiana* strain GHA (128924) (BoteGHA™ ES, BotaniGard® ES, Mycotrol® ESO). The labels for *B. bassiana* provide a 5–10-day application interval unless insect populations are high and may require an application interval of 2-5 days.

Applications would focus on the time of year when SLF is most likely to enter these areas, although applications may occur from May through first freeze (November) depending on the product used. Treatments using high-pressure hydraulic sprays would reach as high as 30 to

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[3] Surfaces may include hedges, fences, light poles, buildings (the bifenthrin and beta-cyfluthrin labels limit applications to the side of buildings up to a maximum height of 3 feet above grade), and other structural elements

40 feet high in the tree, including the bole and canopy, with a droplet size of 226 to 400 microns.

Bifenthrin and beta-cyfluthrin may be applied via mist blowers (Figure 6) on trees and vegetation at the following use sites:

- rail rights-of-way,
- train yards,
- intermodal facilities - these facilities can include docks, can be part of a port facility (on-dock or near-dock facilities), or be a stand-alone inland terminal. The terminals may include areas where trailers are transported on rail and then offloaded and driven off by trucks (tractors) or vice versa,
- trucking depots, (areas where trucks pick-up and deliver cargo; can include perimeter fences),
- airports
- road rights-of-way, includes public roads (e.g., highways, secondary roads),
- distribution centers (large distribution warehouses, where trucks unload cargo at a facility),

Figure 6. Mist blower that will be used on railways to treat SLF.

The insecticide application rates that will be applied using mist blowers are:

- Bifenthrin: 1.0 fluid ounce per 1,000 square feet. Treatment will occur from emergence through adult stage (April through October). The bifenthrin label indicates a minimal application interval of 28 days.
- Beta-cyfluthrin: 0.54 fluid ounce per 1,000 square feet. Treatment will occur from emergence through adult stage (April through October). The label for beta-cyfluthrin indicates a minimal application interval of 7 days.

The number of mist blower applications that will occur at a site will range from one to four applications for either insecticide dependent upon the density of SLF and resources available for additional applications. Treatment areas for mist blowers can vary from 0.5 to over 50 acres. The program will take vegetative, water, and sediment samples to monitor for spray drift.

Table 2 shows a side-by-side comparison of the use sites for the pesticides used in knock-down treatments based on the application method. Table 3 and Table 4 summarize the SLF Program's control treatments, use sites, and application methods.

For all knock-down treatments, applicators will be careful when treating plants adjacent to water bodies, particularly for pyrethroids which are extremely toxic to fish and aquatic invertebrates. All required buffers will be followed according to the label to protect aquatic resources. For mist blower and high-pressure hydraulic spray applications of bifenthrin and beta-cyfluthrin, the Program imposes a 150-ft no treatment buffer from aquatic resources and a 500-ft no treatment buffer from habitats, including critical habitats, of federally listed threatened and endangered (T&E) species. A 150-foot no treatment buffer will reduce pesticide drift by 98.8% (see Appendix A for complete ecological risk assessment on the use of mist blowers and high-pressure hydraulic treatments to apply bifenthrin and beta-cyfluthrin). For all knock-down treatments, the Program avoids exposing bees to direct treatment, spray drift, or residues on blooming plants or while bees are actively visiting the treatment area.

In addition, the following measures that are on the bifenthrin label will be applied for all insecticide use and to all water bodies in the SLF Program regardless of whether its specifically stated on the label to protect waterbodies from drift and runoff:

- Do not apply when wind direction favors downwind drift towards nearby water bodies.
- Do not apply when wind velocity exceeds 5 mph.
- Do not treat areas to the point of run-off.
- Do not make applications during rain.

Table 2. Use sites for bifenthrin, beta-cyfluthrin, and *Beauveria bassiana* during knock-down sprays.

Use Site	Bifenthrin, beta-cyfluthrin and *Beauveria bassiana* applied with high-pressure hydraulic sprayer, handheld tank sprayer, or backpack sprayer	Bifenthrin and beta-cyfluthrin applied with mist blowers
On *A. altissima* and ornamental tree trunks in commercial/residential areas	X	--
In and around the following:	***Perimeter areas and surfaces***	***Trees and vegetation***
– rail rights-of-way	X	X
– train yards	X	X
– intermodal facilities		X
– airports	X	X
– seaports	X	--
– trucking depots	X	X
– road rights-of-way	X	X
– distribution centers	X	X

Soybean Oil Treatment for Egg Masses

Soybean oils used as insecticides are derived from soybean seeds. Insecticide oils can block the air holes through which insects breathe, causing them to die from asphyxiation; act as poisons by interacting with the fatty acids of the insect and interfering with normal metabolism; and disrupt how an insect feeds (Cranshaw and Baxendale 2013). The Program may use Golden Pest Spray Oil™ (GPSO), which is 93% food grade soybean oil. It controls all life stages of most soft-bodied insects and mites by suffocation. Treatment with oil will prevent SLF eggs from hatching. The Program would make applications during the winter to target egg masses of SLF on tree trunks and nursery stock. Equal amounts of GPSO and water are mixed and applied to egg masses as a 50% mix. The Program uses a backpack or handheld sprayer to completely saturate egg masses.

Circle Traps (Dichlorvos (DDVP))

Dichlorvos (DDVP) is an organophosphate insecticide that is widely used in treating domestic animals and livestock for internal and external parasites, to control insects commercially and in homes, and to protect crops from insects (USEPA 2007). Dichlorvos is also found in dog and cat flea collars (USEPA 2007). APHIS currently uses dichlorvos in traps for the agency's Fruit Fly Program.

The circle traps used in the SLF Program contain a dichlorvos toxicant strip. The circle trap is a circle of mesh wrapped around the trunk of *A. altissima* and other host trees. SLF crawl up the tree into a funnel of mesh, and the mesh funnels them into an enclosed container from which they cannot escape. Dichlorvos kills the insects captured in the circle trap.

Table 3. SLF Program pesticide treatments, use sites, and application methods: Herbicides for *A altissima*

Chemical	Use site (*A. altissima*)	Application method
Aminopyralid	Resprouts from stumps	Foliar application with a backpack sprayer
Glyphosate	Resprouts from stumps	Foliar application with a backpack sprayer
Imazapyr	Stumps and small trees	Stumps: hand painted or applied with a backpack sprayer Small trees: Injected into girdling wounds or basal bark spray
Metsulfuron-methyl	Stumps and small trees	Stumps: hand painted or applied with a backpack sprayer Small trees: Injected into girdling wounds or basal bark spray
Triclopyr BEE	Stumps and small trees	Stumps: hand painted or applied with a backpack sprayer Small trees: Injected into girdling wounds or basal bark spray

Table 4. SLF Program pesticide treatments, use sites, and application methods: Insecticides

Chemical	Use site	Application method
Dinotefuran	Tree trunks of trap trees	Basal trunk spray using hand-held or backpack sprayers or trunk injection; one application per year.
Imidacloprid	Tree trunks of trap trees	Trunk injection; one application per year
B. bassiana	Ornamental and *A. altissima* tree trunks in commercial and residential settings (knock-down sprays)	High-pressure hydraulic treatments from a truck- or ATV-mounted tank, handheld tank sprayer, or backpack sprayer; applications may occur 5-10 days from about May through first freeze
B. bassiana	Perimeter areas and surfaces in and around railway easements/train track rights-of-way, train yards, airports, seaports, trucking depots, road rights-of-way, distribution centers (knock-down sprays)	High-pressure hydraulic treatments from a truck- or ATV-mounted tank, handheld tank sprayer, or backpack sprayer; applications may occur 5-10 days from about May through first freeze

Chemical	Use site	Application method
Bifenthrin OR Beta-cyfluthrin	Ornamental and *A. altissima* tree trunks in commercial and residential settings (knock-down sprays)	High-pressure hydraulic treatments from a truck- or ATV-mounted tank, handheld tank sprayer, or backpack sprayer; applications may occur every 7 days for beta-cyfluthrin and every 28 days for bifenthrin from about May through first freeze
Bifenthrin OR Beta-cyfluthrin	Perimeter areas and surfaces in and around railway easements/train track rights-of-way, train yards, airports, seaports, trucking depots, road rights-of-way, distribution centers (knock-down sprays)	High-pressure hydraulic treatments from a truck- or ATV-mounted tank, handheld tank sprayer, or backpack sprayer; applications may occur every 7 days for beta-cyfluthrin and every 28 days for bifenthrin from about May through first freeze
Bifenthrin OR Beta-cyfluthrin	On trees and vegetation at the following use sites: railway easements/train track rights-of-way, train yards, intermodal facilities, trucking depots, airports, road rights-of-way, distribution centers (knock-down sprays)	Mist blower treatments; applications may occur every 7 days for beta-cyfluthrin and every 28 days for bifenthrin from about May through first freeze
Soybean oil	SLF eggs on trees and nursery stock	Hand-held and backpack sprayers; applied during winter and early spring
Dichlorvos	Within circle trap containers placed on *A. altissima* tree trunks	Vapor releasing strips

B. No Treatment Alternative

Under the no treatment alternative, APHIS will not provide funding for SLF control. Other government agencies and private landowners may work to control or eradicate SLF; however, there will be no cooperative or coordinated efforts involving APHIS. If any SLF control actions are taken, efforts will primarily be completed by State and local agencies, growers, and landowners.

C. No Action Alternative

Under the no action alternative, APHIS would continue the current program actions, as analyzed in the October 2021 supplemental EA titled “Spotted Lanternfly Control Program in the Mid-Atlantic Region, North Carolina, Ohio, and Kentucky Supplemental Environmental Assessment” (available online at https://www.aphis.usda.gov/plant_health/ea/downloads/2021/supplemental-slf-mid-atlantic-october-2021.pdf (last accessed December 2, 2022) (USDA APHIS 2021)). The control efforts are the same as those described in the preferred alternative above, except: 1) The Program would not expand to include the states of Indiana, Massachusetts, Michigan, and Rhode Island; 2) the Program would not add high-pressure water treatments to remove SLF egg masses from inanimate objects and equipment; 3) ground-based mist blower and hydraulic spray applications would not occur along road rights-of-way, 4) the Program would continue to limit mist blower applications to rail rights-of-way in certain counties within the EA's geographic scope:

- Maryland - Alleghany, Frederick, and Washington Counties.
- Ohio - Belmont, Carroll, Columbiana, Harrison, and Jefferson Counties.
- Pennsylvania - statewide.
- Virginia - Albemarle, Augusta, Bath, Clarke, Frederick, Highland, Loudoun, Nelson, Page, Rockbridge, Rockingham, Shenandoah, and Warren Counties.
- West Virginia - Berkeley, Brooke, Hancock, Jefferson, Morgan, and Ohio Counties.

Under the no action alternative, APHIS will continue to use a combination of control measures in an integrated manner on an as-needed basis when there are SLF detections.

D. Alternative Considered and Dismissed

Biological Control by Parasitoids

Natural predation of SLF by spiders, praying mantis, spined soldier bugs within the U.S. occurs but the levels are not high enough for dependable SLF control. Natural predation is believed to be much higher in China than in the U.S.; SLF is only occasionally a problem in China during years which favor a SLF population boom (Cornell University 2021). Two parasitoids found in China that evolved in tandem with SLF are *Anastatus orientalis*, an egg parasitoid, and *Dryinus sinicus*, a nymphal parasitoid, which attack the second and third instar nymphs of SLF. Numerous researchers are testing the potential of these two parasitoids as biocontrol agents in the U.S. Exploratory survey studies of SLF biological control organisms in China have occurred (Xin et al. 2021); and life history and rearing studies of *Anastatus orientalis* have occurred (Broadley et al. 2021). However, biological control of SLF by parasitoids is still not very well understood and cannot be considered as a viable option at this time.

III. Potential Environmental Consequences

The below sections consider and compare the potential environmental consequences under the preferred alternative, no treatment, and no action alternatives by summarizing information associated with the physical environment (i.e., air, water, and soil), biological resources (i.e., vegetation and wildlife), human health and safety, equity and underserved communities, Tribal consultation, and any potential historic and cultural resources. The potential impacts may be direct, indirect, and of short or long duration. The impacts may be either beneficial or adverse.

A. Preferred Alternative

This section considers the potential environmental consequences for the preferred alternative. Potential impacts from tree bands and circle traps, detection and visual reconnaissance surveys, egg mass scraping, and manual removal of *A. altissima* trees have extremely low risks. The impacts of these Program actions are discussed in prior Program EAs (summarized in section I.C) and are incorporated by reference. These Program actions are not discussed further in this EA except for the insecticide dichlorvos which is used in insecticidal strips in circle traps.

Potential negative environmental consequences from the spread of SLF, namely impacts to vegetation (e.g., weakening of grape vines) and subsequent indirect impacts to humans (economic losses incurred due to decrease grape production), are expected to decrease when compared to the no action and no treatment alternatives. The preferred alternative is expected to further reduce the likelihood of SLF populations becoming well-established across the country when compared to the no action and no treatment alternatives, minimizing further impacts of SLF on the environment, the public, and program operating costs.

1. Herbicide Considerations

Environmental Fate and Toxicity of Program Herbicides

This section summarizes the environmental fate and toxicity of the herbicides prescribed for use by the SLF Program. The information for triclopyr, imazapyr, and metsulfuron-methyl comes from Appendix E in the APHIS Asian Longhorned Beetle Eradication Program Programmatic Environmental Impact Statement (EIS), which is incorporated by reference (USDA APHIS 2015). The information for aminopyralid and glyphosate comes from U.S. Forest Service’s risk assessments (USDA FS 2007; 2011a). Consult these documents for additional details.

Triclopyr (Triclopyr Butoxyethyl Ester (BEE))

The herbicide triclopyr BEE imitates a plant hormone (indoleacetic acid) that is used to control woody plants and broadleaf weeds (USDA FS 2011c). The triclopyr formulation (triclopyr butoxyethyl ester (BEE) (Garlon® 4 Ultra), can cause slight temporary eye irritation during application as well as some skin irritation in cases of prolonged exposure (USDA FS 2011c). Acute oral median lethal concentrations are 1,000 milligrams(mg)/kilogram (kg) with acute inhalation and dermal toxicity median lethality values greater than the highest test concentration suggesting low acute mammalian toxicity under various exposure pathways. Triclopyr BEE is not considered carcinogenic or mutagenic and in cases where developmental and reproductive studies demonstrate effects, doses were at levels considered to be maternally toxic (USEPA 1998).

Triclopyr BEE is slightly toxic to birds, moderately toxic to highly toxic to freshwater fish and estuarine/marine invertebrates, slightly to moderately toxic to freshwater invertebrates, and highly toxic to estuarine/marine fish (USEPA 1998). The primary metabolite of triclopyr BEE, triclopyr acid, is considered practically non-toxic to aquatic organisms, based on available toxicity data (USEPA 1998).

Triclopyr BEE vapor pressure indicates it can volatize. The Program uses backpack sprayers or hand painting to apply herbicides; for spraying, the Program uses large coarse droplets. Drift is not anticipated to be significant. Mobility studies are not required for Triclopyr BEE because it degrades rapidly in soils (USEPA 1998).

Aminopyralid

The following information about aminopyralid is taken directly from (USDA FS 2007):

> *Aminopyralid is a systemic selective carboxylic acid herbicide that affects plant growth regulators, or auxins, and has multiple non-agricultural uses. The mammalian toxicity of aminopyralid is relatively well-characterized in experimental mammals in a series of toxicity studies that are required for pesticide registration. In standard experimental toxicity studies in rats, mice, rabbits, and dogs, aminopyralid has low acute and chronic oral toxicity. It seems reasonable to assume the most sensitive effects in wildlife mammalian species will be the same as those in experimental mammals (e.g., changes in the gastrointestinal tract, weight loss, and incoordination).*
>
> *Results of acute exposure studies in birds indicate that avian species appear no more sensitive than experimental mammals to aminopyralid in terms of acute lethality. In terms of non-lethal effects, however, birds may be somewhat more sensitive than mammals to aminopyralid after gavage exposures. In developmental studies involving gavage dosing, no*

> *observed adverse effect level (NOAEL) values for mammals are in the range of 200 mg acid equivalent (a.e.)/kg body weight (bw)/day. In birds, the single dose gavage NOAEL is 14 mg a.e/kg bw. Birds are much less sensitive to dietary exposures compared to gavage exposures with NOAEL values for 5-day dietary exposures of over 1,000 mg a.e./kg bw/day.*
>
> *A standard set of toxicity studies are also available on terrestrial plants. Dicots are substantially more sensitive to aminopyralid than monocots. Relatively little information is available on the toxicity of aminopyralid to terrestrial invertebrates or terrestrial microorganisms. Based on bioassays in honeybees, earthworms, and soil microorganisms, aminopyralid does not appear to be very toxic to terrestrial invertebrates or soil microorganisms.*
>
> *There is no indication that aminopyralid is likely to be toxic to aquatic animals based on standard acute and chronic bioassays in fish and invertebrates as well as one acute toxicity study in a species of frog. As would be expected from an herbicide, some aquatic plants are more sensitive than aquatic animals to the effects of aminopyralid. Duckweed, the one macrophyte on which a bioassay of aminopyralid has been conducted, does not appear to be sensitive to aminopyralid.*

In chronic exposure studies on birds, aminopyralid did not result in detectable adverse effects. The NOAEL in the bobwhite quail and mallard duck is 2,500 mg/kg diet and 2,623 mg/kg diet, respectively (USEPA 2020c).

The USEPA has classified aminopyralid as practically non-toxic to aquatic-phase amphibians, practically non-toxic to freshwater invertebrates, practically non-toxic to the estuarine/marine mysids and slightly toxic to the estuarine/marine mollusks (USEPA 2020c).

In a U.S. Forest Service risk assessment (USDA FS 2007), no risks to workers or members of the public were anticipated based on the toxicity of aminopyralid and the potential exposure to aminopyralid. The risk assessment evaluated the highest application rate and three application methods: direct ground spray, broadcast ground spray, and aerial spray. The SLF Program primarily makes direct ground spray applications using backpack sprayers and does not use aerial spray. Although aminopyralid environmental fate properties indicate it is mobile to highly mobile in soil, non-persistent to persistent in soil and is expected to reach off-target water bodies via spray drift, runoff, and leaching (USEPA 2020c), the Program’s use pattern reduces the potential for off-site movement.

Imazapyr and Metsulfuron-methyl

Imazapyr is a systemic, non-selective imidazolinone herbicide used for the control of a broad range of terrestrial and aquatic weeds that works by inhibiting an enzyme involved in the biosynthesis of amino acids such as leucine, isoleucine, and valine (USDA FS 2011b; WDNR 2012). Metsulfuron-methyl is a sulfonylurea herbicide that inhibits the enzyme that catalyzes the biosynthesis of branched-chain amino acids (valine, leucine, and isoleucine) which are essential for plant growth (USDA APHIS 2015; USDA FS 2004).

Imazapyr and metsulfuron-methyl are a common tank mix partner with triclopyr in the control of woody vegetation. The toxicity of imazapyr and metsulfuron-methyl is considered low for mammals. The formulation containing metsulfuron-methyl, Escort® XP, is considered practically nontoxic to mammals via inhalation, dermal, and oral exposures. All toxicity values were reported as greater than the highest test concentration. In addition, metsulfuron-methyl is not considered to be carcinogenic, nor has it been shown to be a reproductive, teratogenic, or developmental hazard (USDA FS 2004). Escort® XP is considered a slight eye irritant but is not considered a skin irritant or sensitizer. Arsenal®, containing the active ingredient imazapyr, has a similar mammalian toxicity profile to metsulfuron-methyl, and is considered practically nontoxic in acute inhalation, dermal, and oral exposures. Imazapyr is not considered to be a carcinogen or mutagen, and is not known to be a reproductive, teratogenic, or developmental hazard (USDA FS 2011b).

The toxicity of imazapyr and metsulfuron-methyl is low to all nontarget organisms, except for some aquatic and terrestrial plants. Both products are considered practically nontoxic to wild mammals, birds, and terrestrial invertebrates, based on the available acute and chronic toxicity data (USDA FS 2004; 2011b). Toxicity to fish and aquatic invertebrates is very low with median lethal acute concentrations typically exceeding 100 mg/Liter (L) for both chemicals (USDA FS 2004; 2011b). Chronic toxicity to fish and aquatic invertebrates is also considered low, based on the available no observable effect concentration (NOEC) values that have been reported from standardized toxicity studies.

Imazapyr is water soluble and does not appear to bind readily to soil, based on soil adsorption coefficient values that range from 30 to 100 (USDA FS 2011b). Imazapyr degradation and dissipation half-lives are variable, ranging from approximately 25 days to greater than 300 days. Metsulfuron-methyl half-lives in soil range from 17 to 180 days. Reported soil adsorption and water solubility values suggest that metsulfuron-methyl has some mobility. Off-site transport of these two herbicides is not expected as the products are being applied directly by hand. Material is applied using a large droplet size under low volume to minimize drift and ensure application and uptake directly to the sprouting plants.

Glyphosate

Glyphosate is a non-selective post-emergent systemic herbicide that works by inhibiting essential aromatic amino acids important to plant growth (USDA FS 2011a). Glyphosate has a variety of agricultural and non-agricultural uses.

Glyphosate adsorbs strongly to soil and is not expected to move vertically below the six-inch soil layer; residues are expected to be immobile in soil. Glyphosate is readily degraded by soil microbes to aminomethylphosphonic acid (AMPA), which is degraded to carbon dioxide. Glyphosate and AMPA are not likely to move to ground water due to their strong adsorptive characteristics. However, glyphosate does have the potential to contaminate surface waters due to its aquatic uses permitted with some formulations, and through erosion, as it adsorbs to soil particles suspended in runoff.

Glyphosate is low in toxicity to mammals via oral, dermal, and inhalation routes. Glyphosate is no more than slightly toxic to birds and is practically nontoxic to fish, aquatic invertebrates, and honeybees. Fish, amphibians, and most aquatic invertebrates appear to be about equally sensitive to the toxicity of technical grade glyphosate and glyphosate formulations, and any differences in response to exposure are more likely attributable to experimental conditions, particularly pH, than to species differences. The sensitivity of algae to glyphosate and glyphosate formulations varies among species; however, the data regarding differences among species of aquatic macrophytes are less complete (from (USDA FS 2011a)).

Impacts of Herbicide Use in the Program

The Program treats *A. altissima* trees with herbicides. The herbicides triclopyr BEE, imazapyr, metsulfuron-methyl, aminopyralid, and glyphosate are applied following label instructions. Applications to stumps would be by hand painting, physical wounding the stump and injecting the herbicide, or spraying the stump using a backpack sprayer. Applications to small trees would be by injection into girdling wounds or applied using a backpack sprayer to bark at the base of the tree. Herbicide treatments usually occur June through September, although stump and trunk applications may occur during winter months. Foliar applications of glyphosate or aminopyralid would be made to re-sprouts from stumps outside of wetland areas from June through September.

The Program's herbicide use pattern and herbicide label instructions minimize damage to nearby vegetation from drift and runoff. Impacts to human health and the environment from the prescribed herbicide applications are anticipated to be incrementally minor in comparison to existing agricultural and non-agricultural (e.g., right-of-way and forestry) uses. The U.S. Forest Service (USDA-FS) uses triclopyr and, to a lesser extent, imazapyr in many of its invasive weed control programs (USDA FS 2011c). The use of herbicides in the SLF Program as prescribed is not expected to contribute significantly to the overall use of herbicides by other entities.

APHIS evaluated the potential human health and ecological risks from the Program’s use of triclopyr, imazapyr, and metsulfuron-methyl for the Agency’s Asian Longhorned Beetle Eradication Program and finds the same risk types and exposures would apply to the SLF Program (USDA APHIS 2015). The U.S. Forest Service evaluated human health and environmental risk for aminopyralid and glyphosate and found low risk based on the toxicity profile of both herbicides (USDA FS 2007; 2011a). The SLF Program’s use pattern for aminopyralid and glyphosate indicates similar low risks to human health and the environment.

The risks to human health are expected to be negligible based on limited exposure from the Program’s use pattern of these herbicides (hand painting, backpack spraying, injection). The risk of exposure is greatest for workers who will apply the product. The potential exposure to Program workers is low with proper use of required personal protective equipment. The potential exposure to other people is also minimal provided the Program adheres to the prescribed use patterns. Risks were quantified for workers and the general public and shown to be low even in extreme exposure scenarios such as accidental spills, indicating exposure is unlikely to cause adverse health effects (USDA APHIS 2015; USDA FS 2007; 2011a). Any activities on private property related to SLF, including herbicide treatment of *A. altissima*, would only occur with landowner permission.

The risks posed by Program use of herbicide to nontarget fish and wildlife also are minimal. The prescribed use pattern reduces potential exposure to most nontarget fish and wildlife. Wild mammals and birds are at very low risk from herbicide applications due to the low toxicity of SLF Program herbicides and the lack of anticipated effects to food sources for these animals. Aquatic organisms are also at low risk based on the favorable toxicity profile and expected low residues that could occur in aquatic environments from Program herbicide applications. There would be some risk to nontarget terrestrial plants from herbicide treatments. However, the potential for effects would be restricted to areas immediately adjacent to any application.

2. Insecticide Considerations

Methods of Insecticide Application

Tree injections of insecticides can mean lower rates of active ingredients, decreased amount of overall chemical product used, and increased length of protection from pests. Drift on and into surrounding vegetation and water bodies is not an issue with tree injections. The use of hand-held, backpack and truck-mounted sprayers still allows applicators to have good control over the distribution of the insecticides applied. Treatments can be relatively exact, drift and the unintentional spraying of nontargets is minimized.

The use of mist blowers and high-pressure hydraulic sprays to apply bifenthrin or beta-cyfluthrin can be more effective than hand-held and backpack sprayers for treating SLF. Mist blowers and high-pressure hydraulic sprays can treat large outdoor areas quickly, disperse the insecticide into areas of dense foliage, and reach higher branches and foliage than other spray options. However, this increased efficacy comes at a potential cost to the environmental health. The ability for the insecticide to be sprayed over a greater area also means an increased chance for spray drift. To ensure minimal impacts from mist blowers and high-pressure hydraulic sprays, it is extremely important to adhere to label mitigations. In addition, the following measures that are on the bifenthrin label will be applied for all insecticide use and to all water bodies in the SLF Program regardless of whether its specifically stated on the label to protect waterbodies from drift and runoff:

- Do not apply when wind direction favors downwind drift towards nearby water bodies.
- Do not apply when wind velocity exceeds 5 mph.
- Do not treat areas to the point of run-off.
- Do not make applications during rain.

When applying insecticides with a mist blower or high-pressure hydraulic spray, the Program follows a minimum 150-foot no-treatment buffer around any aquatic habitat to protect surrounding waterbodies and aquatic species (see Appendix A for the risk assessment supporting this buffer). The Program follows a 500-foot no-treatment buffer in treatment areas that are in proximity to federally listed T&E species and their critical habitats.

Under this alternative, the Program would expand mist blower and high-pressure hydraulic spray applications of bifenthrin and beta-cyfluthrin to include rail and road rights-of-way throughout the Program area where human-mediated movement of SLF is likely. In the Program area (Figure 4) there are thousands of miles of rail and road rights-of-way; table 4 shows a subset of these miles that occur in the Program area. Table 4 provides the total number of miles of freight railroad and public roads, and the number of rail intermodal facilities in Indiana, Massachusetts, Michigan, and Rhode Island. However, the Program would only treat rights-of-way segments that would contribute to SLF spread.

Table 5. Miles of freight railroad and public roads, and the number of rail intermodal facilities in Indiana, Massachusetts, Michigan, and Rhode Island.

State	Freight railroad (miles) as of 2020	Public road (miles) as of 2020)	Number of Intermodal Facilities (as of 2022)	Data Source
Indiana	4,041	97,110	2	(USDOT 2020; 2022)
Massachusetts	1,000	36,815	4	(USDOT 2020; 2022)
Michigan	3,465	122,040	5	(USDOT 2020; 2022)
Rhode Island	93	6,025	0	(USDOT 2020; 2022)

Environmental Fate, Toxicity, and Impacts of Program Insecticides

Bifenthrin

The bifenthrin product used for knock-down treatments is Talstar® P (7.9% a.i.). Bifenthrin is a synthetic pyrethroid insecticide made to mimic natural pyrethrins that are refined from chemicals found in chrysanthemum flowers. Pyrethroids alter insect nerve function, causing paralysis in target insect pests, eventually resulting in death (USEPA 2020j). Bifenthrin controls a broad-spectrum of insects and mites in agricultural and residential settings, both indoor and outdoor on trees, shrubs, foliage plants, non-bearing fruit and nut trees, and flowers in greenhouses, indoor and outdoor plant displays.

Bifenthrin has low acute toxicity via the dermal and inhalation routes of exposure and has high acute toxicity via the oral route (USEPA 2020i). The reported median lethality value in mammals ranges from 53.8 to 70.1 mg/kg. Bifenthrin is not considered to be a dermal sensitizer or an eye or skin irritant (USEPA 2008). Acute effects of the formulation appear to be similar or less than the technical active ingredient, based on available data on the safety data sheet. Bifenthrin is not considered a reproductive or developmental toxicant; however, it is considered a potential carcinogen, based on the formation of urinary bladder tumors when administered at high doses to mice (USEPA 2020i). Human incident (poisoning) data indicate health effects were primarily neurological, respiratory, dermal, and gastrointestinal; were mild/minor to moderate and resolved rapidly. Most incidents occurred in residential settings, with 33 percent of exposures due to homeowner mixing/loading or applying the product (USEPA 2020i).

Humans may be exposed to bifenthrin in food and drinking water; bifenthrin may be applied to crops and applications may result in residues of bifenthrin reaching drinking water (USEPA 2020i). However, risk to ground and surface drinking water resources are not expected to be significant for the Program’s prescribed use pattern, based on label restrictions regarding the protection of surface water and the environmental fate properties for bifenthrin that demonstrate low solubility and a high affinity for binding to soil (USEPA 2010c; 2016c).

Bifenthrin has low to slight toxicity to birds, moderate acute toxicity to wild mammals, and slight toxicity to terrestrial-phase amphibians and reptiles on an acute basis (USEPA 2010a; 2016a). Aquatic vascular plants are not sensitive to pyrethroids (USEPA 2016c). Significant exposure and risk to nontarget terrestrial vertebrates are expected to be minimal due to its toxicity profile and the Program's prescribed use pattern. Any incidental contact by terrestrial invertebrates could result in toxicity because pyrethroid insecticides are toxic to most terrestrial invertebrates. Bifenthrin is very highly toxic to honeybees (USEPA 2016a). The USEPA has identified potential acute risks of concerns to bees and other terrestrial invertebrates from use of pyrethroids (USEPA 2016c). To reduce potential impact to pollinators, the label indicates plants in bloom may be hand sprayed at times when pollinating insects are not present, such as early morning or late evening.

Like other pyrethroid insecticides, bifenthrin is considered highly toxic to fish and aquatic invertebrates. Toxicity values for both groups of organisms range from the low parts per trillion (ppt) to the low parts per billion (ppb), depending on the test species and conditions (Solomon et al. 2001; USEPA 2010c). Bifenthrin binds tightly to soil and has very low solubility, reducing the potential for transport and exposure to aquatic organisms (USEPA 2010c; 2016c). The high octanol/water partition coefficient suggests that bifenthrin is highly bioaccumulative in fish with relatively slow depuration (process of freeing impurities). This is confirmed by the bioaccumulation in fish studies. Risks to all aquatic animals are a dominate concern with pyrethroids (USEPA 2016c). Due to the method of application, the Program's use pattern, and its environmental fate properties, bifenthrin is not expected to runoff or drift from the point of application in quantities that could impact aquatic resources because treatments occur to materials in a localized area. Any bifenthrin that could move offsite would not be expected to impact surface or groundwater. Bifenthrin is not identified as a cause of impairment for any water bodies listed as impacted under section 303(d) of the Clean Water Act; however, pyrethroids as a group have been identified as cause for impairment for three water bodies in Central Valley, California, none of which are in the SLF Program area (14 states and the District of Columbia) (USEPA 2010a).

Bifenthrin does degrade slowly in soil and sediment, based on field terrestrial and aquatic dissipation data (USEPA 2010c). Dissipation half-lives range from approximately 80 days to greater than one year under different soil and sediment conditions. Impacts to air quality from volatilization from water and soil surfaces is not expected due to the low vapor pressure for bifenthrin (USEPA 2010c). Bifenthrin strongly adsorbs to soil particles and organic matter, further reducing volatilization (USEPA 2010c).

Potential impacts of bifenthrin to human health and the environment from basal tree trunk sprays are expected to be low, provided all label use directions are followed. Bifenthrin label limitations which protect human health and the environment include:

- Not applying when wind speed exceeds 5 miles per hour.
- No more than one treatment every seven days.
- No applications to food crops.
- Bifenthrin treatments will all be made outdoors.
- Humans and pets may not re-enter treated area until the area is dry.
- Applicators must wear a long-sleeved shirt and long pants, socks, shoes, chemical-resistant gloves, and a respiratory device and protective eyewear when working in non-ventilated spaces.

The product manufacturer recommends the use of an alternate class of chemistry in the treatment program to prevent or delay pest resistance.

The application of bifenthrin with a mist blower or high-pressure hydraulic spray will increase the potential for impacts to the environment and human health due to the increased height of the spray application and the increased risk of spray drift and runoff. Pesticide label application rates and SLF Program mitigations outlined in the section, “Methods of insecticide application” must be followed to minimize impacts. There will be a minimum 150-foot no-treatment buffer around an aquatic habitat to protect surrounding waterbodies and aquatic species; spray drift is reduced 96.8% with the application of a 150-foot buffer (Appendix A). A 500-foot no-treatment buffer is used to protect habitats, including critical habitats, of federally listed T&E species. The buffers will also mitigate the likelihood of runoff from applications of bifenthrin.

Beta-cyfluthrin

The beta-cyfluthrin product used for high-pressure hydraulic spray and mist blower treatments is Tempo® SC Ultra 11.8%. Like bifenthrin, beta-cyfluthrin is a synthetic pyrethroid compound made to mimic natural pyrethrins that are refined from chemicals found in chrysanthemum flowers. Pyrethroids alter insect nerve function, causing paralysis in target insect pests, eventually resulting in death (USEPA 2016c; 2020j). Beta-cyfluthrin controls a broad-spectrum of insects and mites in agricultural and residential settings, both indoor and outdoor on trees, shrubs, foliage plants, non-bearing fruit and nut trees, and flowers in greenhouses, indoor and outdoor plant displays.

The acute oral median lethal toxicity of cyfluthrin is considered low to moderate for mammals (USEPA 2010b). Inhalation and acute dermal toxicity are considered low. There is no evidence of genotoxic potential, delayed neurotoxicity, carcinogenic potential, or reproductive effects (FAO 2016). USEPA classifies beta-cyfluthrin as “not likely to be carcinogenic to humans” (USEPA 2020g).

Beta-cyfluthrin is an isomeric enriched form of cyfluthrin. Cyfluthrin is considered practically nontoxic to birds with acute oral median lethal toxicity values greater than 2,000 mg/kg (USEPA 2010b). Pyrethroids do not pose a risk to terrestrial and aquatic plants (USEPA 2016a).

The broad-spectrum activity of cyfluthrin results in high toxicity to most insects, including pollinators. The 48-hour contact median lethal dose for honeybees is 0.037 micrograms (µg)/bee (USEPA 2010b; 2016a). Adherence to cyfluthrin label requirements regarding the protection of honeybees will reduce exposure and risk to honeybees and other pollinators. USEPA has determined that incident reporting will be added to labels to encourage users to report bee kill incidents to USEPA (USEPA 2020f). Cyfluthrin has low toxicity to earthworms and other soil macro- or micro-organisms (FAO 2016).

Cyfluthrin is highly toxic to fish and very highly toxic to most aquatic invertebrates (USEPA 2016a). The greatest risk to aquatic resources is through drift from cyfluthrin applications. Off-site transport from drift to aquatic resources is minimized with ground-based equipment, adherence to application buffers and Program mitigations.

Cyfluthrin half-lives in soil are variable depending on pH and organic matter. Laboratory and field dissipation half-lives range from approximately 30 to 94 days. Once cyfluthrin reaches the soil, it binds very tightly to soil particles and is not considered to be water-soluble (USEPA 2016c). The high affinity for soil and low solubility suggests that any cyfluthrin that reaches an aquatic resource will be soil bound or partition very rapidly to the sediment (USEPA 2016c). The lack of mobility suggests that ground water contamination will not be a concern. Surface water quality could be impacted from drift during applications; however, several mitigation measures are stated on the label to protect surface water quality. Cyfluthrin will only occur in the atmosphere during application; however, it will dissipate rapidly and is not expected to volatilize back into the atmosphere, based on its chemical properties. Beta-cyfluthrin is non-volatile under field conditions and slightly volatile from a water surface or wet surface (USEPA 2016c). Its tendency to bind to organic matter reduces the potential to volatilize in the environment (USEPA 2016c).

Application of beta-cyfluthrin sewers and drains is prohibited, as well as to any site where drainage to sewers, storm drains, water bodies, or aquatic habitat can occur. The Program follows the label’s application buffer requirements and imposes all required buffers to protect water resources.

Potential impacts of beta-cyfluthrin to human health and the environment from basal tree trunk sprays are expected to be low, provided all label use directions are followed. People and pets may re-enter a treatment area only after the insecticide is dry. The product cannot be applied to food crops to protect human health. To protect surrounding water, applications may not be made during rain and the treated area may not be watered to the point that run-off occurs. Plants in bloom may be hand sprayed at times when pollinating insects are not present, such as early morning or late evening. Applicators must avoid contact of the product with eyes, skin, or clothing and avoid breathing spray mist.

The application of beta-cyfluthrin with a mist blower or high-pressure hydraulic spray can increase the potential for impacts to the environment and human health due to the increased height of spray application and increased beta-cyfluthrin drift. Pesticide label application rates and SLF Program mitigations (outlined in this chapter under "Methods of insecticide application") must be followed to minimize impacts. There will be a minimum 150-foot no-treatment buffer around aquatic habitats to protect surrounding waterbodies and aquatic species. The Program applies a 500-foot no-treatment buffer from habitats, including critical habitats, of federally listed T&E species. The buffer will also mitigate the likelihood of runoff from applications of beta-cyfluthrin.

Beauveria bassiana

B. bassiana is a fungus found naturally in soil that can be used as a biochemical pesticide or biopesticide to kill or control various insects. The live fungal spores attach to the surface of the insect, germinate, penetrate the exoskeleton, and rapidly grow within the insect, resulting in death of the insect (USEPA 2020h).

B. bassiana is as a broad-spectrum insecticide used against a range of insect pests; the Program will use *B. bassiana* for knock-down treatments. The product used is *Beauveria bassiana* Strain GHA (BoteGHA™ ES, BotaniGard® ES, Mycotrol® ESO). Treatments are made to host material using ground-based equipment, including high-pressure hydraulic treatments. This microbial insecticide has low toxicity to humans in oral, dermal, and inhalation exposures and is not pathogenic (USEPA 2000). Formulations may result in some mild eye irritation.

Very minimal impacts to human health and the environment are expected from the use of *B. bassiana*; it has low toxicity and pathogenicity (USEPA 2000; 2020h). Residues are not expected to remain on treated food or feed and available information indicates that use of the fungus as a pesticide is not expected to have adverse effects on human health or the environment (USEPA 2000; 2020h). Special precautions should still be taken for applicators, such as personal protective equipment (PPE), all of which are outlined on the product labels. *B. bassiana* products can be reapplied as necessary. Intense pest outbreaks may require a combination of the product with a compatible insecticide.

Based on its low toxicity potential, *B. bassiana* is not likely to have adverse effects on the environment, and the potential ecological risk due to exposure to *B. bassiana* is likely to be minimal (USEPA 2020h). *B. bassiana* is not expected to result in significant risks to nontarget fish and wildlife. The fungus is specific to certain insects and has low toxicity to wild mammals, birds, fish, and plants (USEPA 2020h). Nontarget insects that are sensitive to the effects of *B. bassiana* could be impacted but these effects would be localized to the areas of treatment.

Impacts to soil, water, and air quality are not expected from the use of *B. bassiana*. Label restrictions and the environmental fate of the fungus demonstrate it would not persist in the environment and would not occur off-site in aquatic resources in quantities that could result in impacts to the environment. The fungus is not expected to volatilize into the atmosphere and impact air quality.

Dichlorvos

The Program uses dichlorvos insecticidal strips in circle traps. In 2017, APHIS evaluated potential impacts from the use of dichlorvos strips in the APHIS Fruit Fly Program. APHIS found that, provided strips were used according to their label, the probability of exposure to people and the environment (including nontarget organisms) were low and risks to human health and the environment (including nontarget organisms) were negligible (USDA APHIS 2017). The SLF Program would use dichlorvos in a similar manner as the Fruit Fly Program (inside traps) and expects such use to have similar potential impacts.

Dichlorvos volatizes readily in air, has a half-life of 1.5 to 57 days in water, is not known to bioaccumulate in animals or plants, and does not bind to the soil (USEPA 2007).

Dichlorvos is moderately to highly toxic to mammals in oral, inhalation, and dermal acute exposures (USEPA 2005). It is highly toxic to birds on an acute oral toxicity and moderately to practically non-toxic to birds in subacute dietary exposures (USEPA 2005). Dichlorvos is highly toxic to many terrestrial invertebrates due to its broad-spectrum activity, including pollinators (honeybees, butterflies, and moths) (Stanley et al. 2015{Hoang, 2015 #37). Dichlorvos is moderately to highly toxic to fish in acute exposures and has high chronic toxicity for fish (USEPA 2005). It has acute and chronic toxicity to aquatic invertebrates (USEPA 2005). There is no data on its toxicity to terrestrial plants; studies on aquatic plants indicate low toxicity (USEPA 2005).

Dichlorvos has been shown to inhibit acetylcholinesterase and cholinesterase activities in the human nervous system, and effects on nerve functions following dichlorvos exposure during development have been reported (USEPA 2007). However, there is very little risk of human exposure based on the Program's use pattern. Only certified pesticide applicators handle circle traps in the SLF Program. Applicators should avoid contact with eyes and mouth while handling dichlorvos strips and avoid breathing vapors. The strips will be difficult for a small child to access because not only are the dichlorvos strips contained within a chamber that would need to be opened, but the circle traps are also placed at a height on the tree trunk that will be difficult for small children to reach. Additionally, a warning message is placed on the trap.

Dinotefuran

The Program applies dinotefuran to trap trees. The solubility and soil adsorption characteristics of dinotefuran suggest that it is highly mobile (USEPA 2004). Dinotefuran does not break down in water but is somewhat susceptible to microbial degradation and is very sensitive to photolysis. Because of the high mobility and solubility of dinotefuran, there is the potential for leaching into ground water; however, the direct application to the trunks of trees will minimize this type of off-site transport. Dinotefuran is not expected to impact air quality based on the method of application and chemical properties which suggest a low potential for volatilization (USEPA 2004).

Dinotefuran has low toxicity to fish (USDA FS 2009). No effects were observed for freshwater, estuarine/marine fish, and aquatic plants (USEPA 2020e). Risks of concerns were identified to freshwater invertebrates on acute and chronic basis (USEPA 2020e); it is considered highly toxic to some invertebrates (USDA FS 2009). Available toxicity data indicate that degradants of dinotefuran are less toxic to aquatic organisms. Dinotefuran is susceptible to runoff (USEPA 2004); however, the method of application and label requirements suggest that runoff to aquatic habitats would be minimal. Significant drift to sensitive aquatic habitats is not expected based on the method of application. Exposure and risk to aquatic organisms will be minimized by adherence to label requirements regarding applications near water. Risk is expected to be minimal to fish, with an increased risk to some sensitive aquatic invertebrates in very shallow water bodies immediately adjacent to treated trees. Bioaccumulation in aquatic organisms is negligible. Dinotefuran is persistent in aquatic environments except for conditions that favor aqueous photolysis (USEPA 2020e).

According to USEPA, dinotefuran is practically non-toxic to moderately toxic to birds, terrestrial-phase amphibians, and reptiles and practically non-toxic to mammals on an acute basis. The chemical is highly toxic to adult bees on an acute contact and oral basis (USEPA 2020e). No risks were identified for terrestrial plants.

Direct risk is not expected based on conservative estimates of exposure and the available toxicity data. Indirect impacts to wildlife populations through the loss of invertebrate prey are also not expected to be significant because only sensitive terrestrial invertebrates that feed on treated trees will be impacted while other insects would be available as prey items.

Minimal impacts to human health and the environment are expected from tree injections and/or hand-held and backpack spraying of dinotefuran on trap trees. Dinotefuran is classified as “not likely to be carcinogenic to humans” (USEPA 2020e). Dinotefuran has low acute toxicity by oral, dermal, or inhalation exposure routes to humans (USEPA 2020e). While human incidents from the use of dinotefuran are reported to the USEPA, they are of low severity and are not a concern to the agency at this time (USEPA 2020e).

Imidacloprid

Human health and environmental impacts from imidacloprid are as discussed in Appendix F of the Programmatic ALB Eradication EIS (USDA APHIS 2015), which is incorporated by reference. The Program’s use pattern for imidacloprid in the SLF Program is similar to its use pattern in the Asian Longhorned Beetle Program. The Program injects imidacloprid, a neonicotinoid insecticide, into trap trees.

The technical material and several formulations are also considered practically nontoxic to mammals in dermal and inhalation exposures (USDA FS 2016; USEPA 2020d). Acute lethal median toxicity values are typically greater than 2,000 mg/kg and 2.5 mg/L for dermal and inhalation exposures, respectively. Imidacloprid has high oral lethality (USEPA 2020d). Available data for imidacloprid and associated metabolites suggest a lack of mutagenic, carcinogenic, or genotoxic effects at relevant doses. Developmental, immune, and endocrine related effects have been observed in some mammal studies. In all developmental studies the effects to the offspring occurred at doses that were maternally toxic (USDA FS 2016).

Imidacloprid is considered non-carcinogenic for humans. The chemical exhibits high oral lethality and low dermal and inhalation lethality; however, most occupational handler risk estimates were not of concern with appropriate baseline PPE (log-sleeved shirt, long pants, shoes, socks, and possibly gloves) (USEPA 2020d). Human health incidents recorded from January 2016 until August 2019 included 252 reports, 19 were classified as major severity, 233 classified as moderate severity. The 19 severe cases included dermal and neurological symptoms (i.e., headaches, numbness, tingling, and one person reported seizures) (USEPA 2020d). The reported human health incidents were not from APHIS program applications.

Imidacloprid is moderately toxic to mammals on an acute exposure basis; highly toxic to birds on an acute oral exposure basis and slightly toxic on a subacute dietary exposure basis; and very highly toxic to adult honeybees. The chemical was not found to be toxic to terrestrial plants (USDA FS 2016; USEPA 2020d).

Imidacloprid is readily soluble in water and volatilization and bioaccumulation in aquatic organisms is negligible; it is considered persistent in aquatic environments except for conditions that favor aqueous photolysis (USEPA 2020d).

Imidacloprid has low toxicity to aquatic organisms including fish, amphibians, and some aquatic invertebrates. Acute toxicity to fish and amphibians is low with acute median lethal concentrations typically exceeding 100 mg/L (USDA FS 2016; USEPA 2016b). Chronic toxicity to fish is in the low parts per million range, depending on the test species and endpoint. Imidacloprid presents risk of concern to freshwater and saltwater invertebrates on a chronic basis (USEPA 2016b; 2020d). Aquatic invertebrates are more sensitive to imidacloprid when compared to fish, depending on the test species (USDA FS 2016; USEPA 2016b).

APHIS has yet to use imidacloprid in the SLF Program, and any future use is expected to be negligible. Imidacloprid treatments by injection would be highly targeted: injection means there is no drift, eliminating direct contact of the insecticide on surrounding vegetation, soil, and vulnerable animals, including pollinators. All mitigations on imidacloprid product labels, such as a limit on the number of treatments per year, must be followed to protect the environment and human health. Imidacloprid does not have the efficacy against SLF that dinotefuran has and is fairly cost-prohibitive. It has not been used, thus far, has not been conducted outside of research and state authority use.

Soybean oil

Very minimal impacts to human health and the environment are expected from the use of soybean oil. Vegetable oils (except for oil of mustard) are of low acute toxicity and are Generally Recognized as Safe by the Food and Drug Administration (FDA), which means the ingredient is considered safe for consumption, and exempted from FDA's usual food additive tolerance requirements. Vegetable oils employ a non-toxic mode of action. The oils are formulated in low concentrations into products that are used at low volumes in the United States, so exposure to humans and the environment is expected to be low (USEPA 1993). USEPA has received no incident reports of adverse effects for vegetable oil pesticides.

The SLF Program may use a 50% soybean oil solution to treat SLF egg masses via spot treatment to trees and nursery stock. Product labels for vegetable oils have precautionary language that is followed by the Program to protect human health and the environment. Because soybean oil and oil vapor are flammable, PPE is required when handling the product. The usage label requires that the oil cannot be applied to water or in areas where surface water is present, and all disposal directions must be followed. No one may re-enter treated areas for four hours unless wearing appropriate protective gear. Since soybean oil is safe for most people to consume, human health impacts are expected to be minimal when used according to the product label. Notification is made in advance of treatment to protect individuals with soy allergies.

Although soybean oil is of low acute toxicity and employs a non-toxic mode of action, all precautionary label statements will be followed by the applicator to protect human health and the environment.

3. Physical Environment

Air

USEPA sets National Ambient Air Quality Standards to protect public health for five major air pollutants: ground-level ozone, particular pollution (also known as particulate matter), carbon monoxide, sulfur dioxide and nitrogen dioxide. USEPA uses the Air Quality Index (AQI) values to indicate overall air quality. AQI considers all the air pollutants measured within a geographic area. In 2021, Indiana, Massachusetts, Michigan, and Rhode Island all reported no days with ‘very unhealthy’ air quality. Massachusetts (Boston-Cambridge-Newton core based statistical area (CBSA)) reported one day as ‘unhealthy’ and Indiana (Chicago-Naperville-Elgin, IL-IN-WI CBSA) reported two days as ‘unhealthy’ (USEPA 2022c). Air quality in the rest of the Program area was covered in prior Program EAs; 2022 data is presented here. In 2022, of the counties reporting their AQI, one county in Pennsylvania (Allegheny County) and one county in North Carolina (Forsyth County) reported one day as unhealthy for sensitive groups; otherwise, no days were reported as unhealthy, very unhealthy, or hazardous in 2022 (USEPA 2022c). Of the counties in Connecticut, Maryland, New Jersey, New York, Virginia, and West Virginia reporting their AQI, no days were reported as unhealthy or hazardous in 2022 (USEPA 2022c). No data was available for Delaware in 2022. Air quality data for each state for every year can be found at https://www.epa.gov/outdoor-air-quality- data/air-quality-index-report (last accessed September 13, 2022).

Some of the herbicides and insecticides prescribed for use in the SLF Program have the potential to impact air quality; however, impacts are expected to be short term, localized, and minor. The application of herbicides and insecticides when an area is in exceedance of air quality standards could lead to cumulative effects in air quality. However, the air quality index in the expanded Program area (including the additional four states and expansion of treatment use sites) is rarely classified as ‘very unhealthy’ or ‘unhealthy’ (USEPA 2022c). Most SLF Program herbicides and insecticides have low to no volatility, or strongly absorb to soil and organic matter, indicating minimum impact to air quality. The insecticide dichlorvos is highly volatile; however, the use pattern of dichlorvos as an insecticidal strip in traps and its rapid degradation in the atmosphere suggest that impacts to air quality are negligible (USDA APHIS 2017; USEPA 2020a).

Mist blowers and high-pressure hydraulic sprays have the greatest potential for impacting surrounding air quality. To ensure that impacts from mist blowers/hydraulic sprays are minimal, it is extremely important to adhere to label mitigations, such as labeled use restrictions for wind direction, wind velocity, rates of application, and spray droplet size. The SLF Program's applications of bifenthrin, beta-cyfluthrin, *B. bassiana*, and soybean oil with basal tree trunk sprays, as well as use of dichlorvos in circle traps, will all have minimal impacts to air quality, provided labels are followed. Boom sprays will be used as per the label, low to the ground, with appropriate nozzle size and facing the appropriate direction to minimize spray drift. While dichlorvos has harmful vapors, the strips will be used in well-ventilated areas and handlers will ensure they avoid breathing in vapors.

Control of *A. altissima* trees could induce impacts to air quality, but impacts will be short term, localized, and minor. Tree death can decrease local carbon sequestration; however, over time, natural succession will offset carbon dioxide release into the atmosphere.

Water

The Clean Water Act (CWA), the Safe Drinking Water Act, and the Water Quality Act are the primary Federal laws protecting the Nation's waters. Federal activities also must seek to avoid or mitigate actions that will adversely affect areas immediately adjacent to wild and scenic rivers (National Wild and Scenic Rivers Act of 1968, as amended (16 USC §§ 1271-1287)). Section 402 of the CWA addresses the National Pollutant Discharge Elimination System (NPDES) including those permits related to the discharge of pesticides to waters of the U.S. The USEPA and the states issue Pesticide General Permits under the NPDES program for specific types of pesticide applications. These uses typically include applications for mosquito control, various weed and algae pest control, animal pest control activities in or near water, and forestry canopy pest control where a portion of the pesticide will be applied over and deposited to water. Other pesticide application sites may be subject to individual permits based on recommendations from either the USEPA or respective state agency. States have responsibility for administration of their respective NPDES permitting programs.

Surface water runoff can affect streams and other water bodies' quality by depositing sediment, minerals, or contaminants. Meteorological factors such as rainfall intensity and duration, and physical factors such as vegetation, soil type, and topography influence surface water runoff (USGS 2018a). Groundwater (e.g., aquifer) levels vary seasonally and annually depending on hydrologic conditions. Groundwater is ecologically important because it supplies water to wetlands, and through groundwater-surface water interaction, groundwater contributes flow to surface water bodies (USGS 2018b). Polluted runoff, known as nonpoint source pollution, occurs when rainfall picks up contaminants such as pesticides, sediment, nutrients, or bacteria on its way to lakes, rivers, wetlands, coastal waters, and ground water. Nonpoint source pollution occurs from activities such as fertilizing a lawn, road construction, pet waste, and improperly managed livestock, crop, and forest lands. Today, States report that nonpoint source pollution is the leading cause of water quality problems (USEPA 2022b).

The eastern temperate forest ecoregion, which includes all of Indiana and Rhode Island, and parts of Massachusetts and Michigan is characterized by an abundance of perennial streams and rivers, small areas with high densities of lakes, and a diversity of wetland communities rich in maritime ecosystems (CEC 1997). The northern forests ecoregion, which includes part of Massachusetts and Michigan, is characterized by extensive boreal forests and a high density of lakes (CEC 1997). The ecoregions for the existing Program area are described in prior EAs.

The expanded SLF Program area contains a cumulative large area of surface waters. Surface water statistics for the previous Program area are summarized in prior EAs. Here we summarize surface water information for the four states added to the Program. Indiana has 67 miles of Great Lakes shoreline and 62,547 river and stream miles (USEPA 2002). Massachusetts has 10,033 miles of perennial rivers/streams, over 196,000 acres of lakes/ponds, 1,510 tidal shoreline, and 574,856 acres of wetlands (MWM 2021). Michigan has 872,000 inland lake acres, 76,000 miles of rivers and streams, and 3,000 Great Lakes shoreline miles (USEPA 2022a). Rhode Island has 159 estuarine square miles, 20,749 lakes/ponds area acres, and 1,420 miles of rivers and streams (USEPA 2022e). Each State has surface water quality listed as impaired (USEPA 2022d); table 5 summarizes surface waters and impairment in IN, MA, MI and RI.

Table 6. Water quality of rivers and streams in Indiana, Massachusetts, Michigan, and Rhode Island.

State	Miles Assessed: Good	Miles Assessed: Impaired	Miles Assessed: Lack Info.	Causes for impairment	Year last report	Reference
Indiana	24,529	12,203	693	Degraded aquatic life, low oxygen, nitrogen and/or phosphorus, metals, acidity, salts, mercury, ammonia, degraded habitat, sediment, bacteria and other microbes, oils and grease, toxic inorganic chemicals, temperature, pesticides, and PCBs	2022	(USEPA 2002) (queried warm water aquatic life use)

State	Miles Assessed: Good	Miles Assessed: Impaired	Miles Assessed: Lack Info.	Causes for impairment	Year last report	Reference
Massachusetts	1,889	1,808	285	Nuisance plants or animals, algae, low oxygen, nitrogen and/or phosphorus, aquatic weeds, degraded habitat, murky water, abnormal flow, salts, biological poisons, total toxic chemicals, acidity, toxic inorganic and organic chemicals	2020	(USEPA 2020b) (queried fish, other aquatic life and wildlife use)
Michigan	13,122	2,585	1,031	Sediment, abnormal flow, low oxygen, salts, degraded habitat, nitrogen and/or phosphorus, unknown cause, metals, murky water, temperature, degraded aquatic life, aquatic weeds, acidity, oil and grease	2022	(USEPA 2022a) (queried warm water fishery use)
Rhode Island	763	281	15	metals, nuisance plants or animals, degraded aquatic life, nitrogen and/or phosphorus, low oxygen, salts, mercury, PCBs, dioxins, murky water, total toxic chemicals and aquatic weeds	2022	(USEPA 2022e) (queried fish and wildlife habitat use)

APHIS considers impacts to water resources as significant if they exceed federal or state water quality standards. Insecticides and herbicides, when used improperly, can end up in surrounding water bodies. The chemicals can reach waterways from direct spray, drift, or spills or via run-off in solution or on soil particles that are moved by hydraulic forces. All program uses of insecticides and herbicides must be away from surface water and follow label directions that eliminate or greatly reduce runoff.

Mist blowers and high-pressure hydraulic spray treatments have the greatest potential for impacting surrounding water quality. In addition, the expanded use sites to include rail and road rights-of-way may increase the number of treatment sites that are in proximity to water resources.

The Program’s expanded geographic area (14 states and the District of Columbia) encompasses a cumulative large area of surface waters; not all surface water will be in proximity to treatment areas. To protect surrounding water bodies from spray drift and runoff, it is extremely important to adhere to label mitigations and follow SLF Program protocol. Per the label, bifenthrin may not be applied over an impervious surface, drainage or other conditions that could result in runoff into storm drains, drainage ditches, gutters, or surface water. Insecticides should not be applied when wind direction favors downwind drift towards nearby water bodies; not applied when wind velocity exceeds 5 mph; do not treat areas to the point of run-off; and not make applications during rain. The Program follows the same application restrictions for beta-cyfluthrin. When applying bifenthrin or beta-cyfluthrin by mist blower and high-pressure hydraulic spray treatments, there must be a minimum 150-foot no-treatment buffer around all waterbodies. Waterbodies include, but are not limited to lakes, reservoirs, rivers, permanent streams, wetlands, natural and manmade ponds, and estuaries. APHIS also requires a 500-foot no-application buffer from habitat, including designated critical habitat, for all federally listed T&E aquatic species that may occur within each SLF Program action area (see Appendix A).

The SLF Program’s applications of bifenthrin and beta-cyfluthrin, *B. bassiana*, and soybean oil with basal tree trunk sprays will all have minimal impacts to water quality, provided labels are followed. Truck-mounted sprays will be used as per the label, low to the ground, with appropriate nozzle size to minimize spray drift. The methods of application that include spot treatments using backpack sprayers must not oversaturating bark, reducing the likelihood of off-site transport of insecticides from drift.

APHIS will conduct environmental monitoring with the use of spray drift card samples and water and/or sediment samples, to assess how effective SLF Program measures are in reducing off-site bifenthrin and beta-cyfluthrin deposition. APHIS will adjust SLF Program risk mitigation measures if bifenthrin and beta-cyfluthrin residues occur adjacent to, or in waterbodies, that could result in potential effects to aquatic nontarget organisms.

There is negligible impact to water resources from dichlorvos because of the Program’s use pattern and label instructions that indicate not to apply directly to water, to areas where surface water is present, or to intertidal areas (Hercon Environmental 2022; Plato Industries Incorporated 2013). Should a trap dislodge and fall into a waterbody, the small amount of dichlorvos in the strip and its rapid degradation through hydrolysis make significant impacts to surface water and groundwater unlikely (USEPA 2006).

A. altissima trees occur throughout the expanded Program area. Control of *A. altissima* trees could induce impacts to water quality, but impacts will be short term, localized, and minor. Changes in canopy cover and evapotranspiration due to *A. altissima* control measures may alter stream flow (Mikkelson et al. 2013), while tree mortality adjacent to aquatic resources could reduce shading and alter water temperatures. Degradation of water quality can in turn negatively affect aquatic organism (Englert et al. 2017; Morrissey et al. 2015). These impacts are expected to be offset over time with natural succession.

Soil

Soil health or soil quality is the ability of soil to function as a vital ecosystem, sustaining plants, animals, and humans (USDA NRCS 2022). Soil is an ecosystem that provides nutrients for plant growth, absorbs and holds rainwater, filters and buffers potential pollutants, serves as a foundation for agricultural activities, and provides habitat for soil microbes to flourish (USDA NRCS 2022).

Many of the activities associated with the SLF Program can result in temporary soil surface disturbance or compaction. The most frequent ground disturbance is caused by vehicle and pedestrian activity. Soil impacts, however, are localized to areas where the Program occurs. APHIS considers that the long-term benefits of controlling SLF outweigh any short-term impacts to soil. *A. altissima* control could account for some impacts to soil including erosion, alterations to soil microflora, and soil compaction (Foote et al. 2015; Li et al. 2004). Best management practices, such as minimizing activities that expose bare soil to assist in rapid revegetation, can reduce impacts (Aust and Blinn 2004; Warrington et al. 2017).

Potential negative effects of herbicide and insecticide application could include decreased or altered microbial populations in the soil (Adomako and Akyeampong 2016); adverse impacts from SLF Program treatments are expected to be short-term and reversible. Tree trunk injections, spot treatment applications using backpack sprayers, and hand painting the pesticide on stumps all reduce off-site transport of insecticides and herbicides into the soil. Similarly, the use of dichlorvos strips in traps prevents them from contacting the soil. Should a trap dislodge, the strip will likely remain inside the trap and not fall out. Should the strip encounter soil, the small amount of dichlorvos in the strip and its rapid volatilization and degradation make significant impacts unlikely (USEPA 2006). Boom sprays and spot treatments using backpack sprayers must not oversaturate bark, reducing the likelihood of off-site transport of insecticides from runoff. Mist blowers and high-pressure hydraulic spray treatments have the greatest potential for impacting soil quality because of the possibility of drift resulting in a larger impacted area. Mist blower and high-pressure hydraulic spray applications will occur in industrial sites and other disturbed areas where soil quality is already impacted but may also occur at railroad and road rights-of-way adjacent to natural and managed habitats. To protect soil quality from spray drift and runoff, it is important to not treat areas to the point of run-off and not make applications during rain. Insecticide resides that may occur in soil due to mist blower and high-pressure hydraulic spray treatments are expected to have minimal impacts to soil invertebrates and microorganisms.

Residues that may occur in soil are subject to degradation reducing exposure over time. Bifenthrin degradation in soil is expected to be slower than beta-cyfluthrin based on longer soil photolysis and microbial degradation half-lives (USEPA 2016a). Bifenthrin residues may accumulate in soil due to slower degradation half-lives when multiple applications occur at a site. Available studies evaluating the acute and chronic effects of bifenthrin and beta-cyfluthrin show moderate to low toxicity to soil dwelling-organisms (Mali 2019; Medo et al. 2015; Tu 1995).

APHIS considers impacts to soil resources as significant if agency activities result in substantially increased erosion and sedimentation or adversely affected unique soil conditions. APHIS does not expect the SLF Program to have this type of impact. If performed as prescribed, none of the actions discussed under the Preferred Alternative is likely to increase the potential for erosion or sedimentation.

4. Biological Resources

Biological resources include plant and animal species and the habitats where they live. For this EA, biological resources will focus on vegetation, nontarget wildlife, and protected species. The plant and wildlife subsections include both native and non-native species. Protected species refers to migratory birds protected under the Migratory Bird Treaty Act of 1918 (MBTA), as amended, T&E species and their critical habitats as protected under the Endangered Species Act (ESA), and bald and golden eagles under the Bald and Golden Eagle Protection Act.

The Program would implement control activities wherever SLF is found. The removal of *A. altissima* trees with herbicides would occur within a ¼-mile radius of positive finds. The Program uses trap trees within a ¼-mile radius of a positive find. The Program would also treat railway lines, intermodal facilities and public road rights-of-way that are considered high risk for spreading SLF. The treatment area along railways and public roads is highly managed and disturbed habitats that receive routine rail and vehicular traffic and other mechanical and chemical treatments to manage unwanted vegetation. While flora and fauna within rights-of-way are exposed to mowing, herbicides, pollution, as well as the facilitated spread of invasive competitors, the green space may also accommodate a high level of species richness, including biota of conservation concern (Gardiner et al. 2018). In addition, APHIS expects public land use areas (includes city, county, state and federal parks, refuges, and wildlife management areas) to occur within one-half mile of some treatment areas where the Program applies mist blowers and high-pressure hydraulic spray treatments. Biological resources in these areas, as well as surrounding urban areas, need to be considered and protected.

Vegetation

A. altissima, the primary host of SLF, is a rapidly growing deciduous tree, native to Taiwan and northeast and central China. The tree was first introduced into Philadelphia in 1784 and then again on the west coast in the 1850s as a valued urban street tree. *A. altissima* has since been widely planted. *A. altissima* in forested areas typically occurs in small patches as canopy trees but can also occupy the understory.

Traits that allow *A. altissima* to be so invasive are: its ability to grow almost anywhere; rapid growth in dense colonies; prolific seed production; its ability to continuously send up root suckers (i.e., shoots that grow from the roots of a plant) as far as 50 feet from the parent tree, even when injured; sprouts as young as two years produce seeds; and, the tree produces chemicals in its leaves, roots, and bark that can limit or prevent the growth of other plants in the area (Jackson et al. 2020). *A. altissima* presents minor human health concerns. As a high pollen producer and moderate source of allergies in some people, skin irritation or dermatitis have been reported; symptoms vary depending on sensitivity of the individual, the extent of contact, and condition of the plant (Jackson et al. 2020).

SLF has many other host trees in addition to *A. altissima.* Host species provide food, shelter, and egg laying sites to SLF. SLF changes hosts as they age and go through various developmental stages (PDA 2022a). Nymphs feed on a wide range of plant species, while adults prefer to feed and lay eggs on *A. altissima*. Appendix B provides a list of confirmed SLF hosts (Barringer and Ciafré 2020).

The combination of favorable climate and abundant presence of hosts indicates that the expanded SLF Program area is highly likely to support the establishment of SLF populations. SLF hosts grow in a wide range of soils (dry to medium moisture), shade conditions (full sun to part shade), and in the presence of urban pollutants (Missouri Botanical Garden 2020).

Actions associated the control of SLF will temporarily increase the presence or level of human activities in the program area, which can, to varying degrees, impact ground vegetation. By utilizing best management practices that limit exposing bare soil, the Program can minimize these impacts.

SLF Program tree bands, traps, and surveys will have minimal impacts to vegetation. There is some risk to nontarget terrestrial plants from herbicide treatments. However, the potential for effects will be restricted to areas immediately adjacent to the application. Herbicides will be applied directly to the tree surface or to exposed areas under the bark (which requires the applicator to wound the bark) according to label instructions to minimize damage to nearby vegetation from drift or runoff. Applications are made by hand to sprouts using a backpack sprayer or to cut stumps using injection, hack and squirt, or other hand applied methods directly to the tree. These methods minimize impacts to surrounding vegetation.

Reduction of *A. altissima* may cause limited alterations to vegetative understory; however, impacts are expected to be local and short-term. By utilizing best management practices during *A. altissima* controls, such as minimizing activities that expose bare soil to assist in rapid revegetation, APHIS can minimize these impacts. The use of dinotefuran, imidacloprid, bifenthrin, beta-cyfluthrin, *Beauveria bassiana*, and soybean oil using tree injection or basal tree trunk sprays will have minimal impacts to surrounding vegetation. While mist blowers and high-pressure hydraulic spray treatments have the potential to reach the greatest area of vegetation, impacts of bifenthrin and beta-cyfluthrin on vegetation will be extremely low. The Program insecticides are not harmful to terrestrial and aquatic plants.

Wildlife

The SLF Program's herbicide treatment of *A. altissima* will result in temporary loss of wildlife habitat that natural succession will restore over time. *A. altissima* in forested areas typically occur in small patches as canopy trees but can also occupy the understory. Changes in canopy cover due to tree control can degrade surrounding water quality, in turn affecting aquatic organisms through direct or indirect impacts to fish, aquatic insects, and crustaceans (Englert et al. 2017; Morrissey et al. 2015). Any potential for impacts to terrestrial and aquatic systems will be localized and transient since *A. altissima* is not considered to be a dominant tree species in large, forested areas of the United States.

Actions associated with the preferred alternative may temporarily increase the presence or level of human activities (noise and visual disturbance) in the Program area. Temporary adverse effects can include increased levels of stress hormones, disturbance or flushing of young broods, and decreased fitness. APHIS expects the adverse effects associated with this concern to be localized and temporary.

Wild mammals and birds are at very low risk from herbicide applications due to the low toxicity of Program herbicides and the lack of anticipated effects to food sources for these animals. Aquatic organisms are also at low risk based on the favorable toxicity profile and expected low residues that could occur in aquatic environments from the Program's herbicide applications (USDA APHIS 2015).

B. bassiana and soybean oil are of such low toxicity they pose few additional risks to nontarget wildlife. The limited use and method of application of dinotefuran and imidacloprid to tree trunks of trap trees keeps effects localized and exposure risks to a minimum. Additionally, dinotefuran has low to moderate acute and chronic toxicity to nontarget wildlife, such as mammals and birds (for more information, see (USDA FS 2009)). Since imidacloprid is only applied via tree injection, insects must feed on the treated plants to be exposed to a lethal dose; therefore, exposure of nontarget organisms is minimized. There are some risks to sensitive terrestrial invertebrates that consume vegetation from imidacloprid-treated trees. However, terrestrial invertebrate populations consume a wide range of plants, which should limit the percentage of exposure through their diet.

The lack of significant exposure to terrestrial vertebrates from dichlorvos applications in the SLF Program suggests negligible risk to this group of nontarget organisms. Similarly, there is a lack of significant exposure to nontarget terrestrial invertebrates due to the formulation of dichlorvos, and its use in traps. Dichlorvos is toxic to pollinators such as honeybees and butterflies; however, the lack of significant exposure due to the use pattern reduces the risk to these groups of invertebrates. There is the possibility of some risk for terrestrial invertebrates that may encounter the strip; however, these effects would be incidental and localized to individual traps.

Program use of mist blower and high-pressure hydraulic spray treatments increases risks to wildlife that consume pyrethroid treated vegetation and invertebrates. Indirect impacts to wildlife populations through the loss of invertebrate prey is not expected to be significant because only sensitive terrestrial invertebrates that feed on treated trees will be impacted while other insects remain available as prey items. Despite the expanded geographical area of the Program, cumulative impacts to terrestrial invertebrates are not anticipated as SLF treatments would only occur at sites with active SLFs and not all sites would be treated at the same time or with the same insecticide. Although it has not been observed within the SLF Program, there is a potential for migrating or foraging animals to alter their patterns or expand their ranges if invertebrate prey becomes limited or unavailable (USDA APHIS 2018).

Bifenthrin is highly toxic to freshwater fish, aquatic-phase amphibians, and terrestrial invertebrates, including beneficial insects such as honeybees and pollinators. The chemical is very highly toxic to freshwater aquatic invertebrates; has very high acute toxicity to estuarine/marine fish and invertebrates; moderate acute toxicity to small mammals; and slight acute toxicity to birds, terrestrial-phase amphibians, and reptiles (USEPA 2010a; 2016c; 2016a; 2020j). Beta-cyfluthrin is highly toxic to fish, aquatic invertebrates, and most terrestrial invertebrates; moderately toxic to algae; highly toxic to honeybees and other arthropod species (USEPA 2016a; 2020j). The 150-foot no treatment buffer adjacent to waterbodies will reduce the risk to aquatic species (see appendix A). Waterbodies include, but are not limited to lakes, reservoirs, rivers, permanent streams, wetlands, natural and manmade ponds, and estuaries. Pesticide label instructions limiting the number of treatments applied and utilizing applications methods that limit or reduce drenching and chemical runoff into soil and nearby water, could minimize impacts to aquatic species. Pesticide application rates and the following SLF Program mitigations would further reduce risks: do not apply when wind direction favors downwind drift towards nearby water bodies; do not apply when wind velocity exceeds 5 mph; do not treat areas to the point of run-off; and do not make applications during rain.

Pollinators

The use pattern of basal trunk injections and hand-held or backpack sprayers and truck mounted boom sprays reduces potential impacts to pollinators, and other sensitive terrestrial invertebrates, because they minimize spray drift or are directed to individual trees (such as with basal trunk injections). Dichlorvos toxicity to pollinators such as honeybees is high (USEPA 2006). Dichlorvos has also been shown to be highly toxic to butterflies and moths (Hoang and Rand 2015). There is a lack of significant exposure to nontarget terrestrial vertebrates and invertebrates, including pollinators, due to the formulation of dichlorvos and its use in traps. USEPA (USEPA 2020h) noted some concern for nontarget beneficial insects from *B. bassiana* based on the entomopathogenic nature of the fungi. USEPA required labeling to mitigate potential effects to honeybees for *B. bassiana*. The application of bifenthrin and beta-cyfluthrin with mist blowers and high-pressure hydraulic spray treatments will increase the potential for impacts to pollinators due to the increased height of spray application and the increased risk of spray drift and runoff. Bifenthrin and beta-cyfluthrin are considered very highly toxic to honeybees based on either acute oral or acute contact studies (USEPA 2016c). Beta-cyfluthrin product labels state that applications made directly to crops or weeds are highly toxic to pollinators, such as bees. The label also states not to make applications or allow drift to crops or weeds where bees are actively foraging. Various plant species occur at sites that may be proposed for SLF treatments; blooming may occur throughout the treatment season for SLF. These sites will be evaluated prior to application to determine if bees and other pollinators are actively foraging. Per label requirements, applications will be avoided at sites where pollinators are foraging, or when conditions are favorable for drift to areas where pollinators are foraging.

Bifenthrin kills bees on contact during application and will continue to kill bees for one or more days after treatment (Krupke et al. 2021). USEPA (2016c) reported residual contact lethal effects to honeybees 10 days after application using a formulation of beta-cyfluthrin. USEPA (2017) evaluated the acute risks to pollinators using a screening level analysis and determined application rates for various insecticides that would be considered safe for pollinators. The application rates for bifenthrin and beta-cyfluthrin that were considered safe to honeybees by USEPA's risk assessment were substantially lower than the rates proposed for the SLF Program's use of mist blower and high-pressure hydraulic spray treatments, suggesting the potential for direct acute risk to honeybees from SLF Program treatments. Bifenthrin and beta-cyfluthrin are broad spectrum insecticides and are also considered toxic to other invertebrate pollinators such as butterflies and moths. Krueger et al. (2021) studied the 72-hour toxicity of bifenthrin and beta-cyfluthrin and their effects on the growth and diet consumption of Monarch butterfly caterpillars. They found the toxicity of bifenthrin to Monarch caterpillars was lower than beta-cyfluthrin.

The risks to pollinators from mist blower and high-pressure hydraulic spray treatments will be reduced with the implementation of risk mitigation measures designed to reduce exposure. Applications will range from 0.5 to 50 acres in size at intermodal areas, distribution centers, truck depots, airports, seaports, and railway and public road rights-of-way. Some of these treatment areas will occur in industrial areas where pollinating plants are not prevalent, reducing insecticide exposure and risk to pollinators. Risks to pollinators in railway and public road rights-of-way that are not in industrial areas would be greater due to the presence of pollinating plants and the importance of these use sites to pollinators. Rights-of-way associated with roads, power lines and rail lines have been identified as having important ecological function to support pollinators in fragmented habitats and to serve as corridors for pollinators between larger foraging resource habitats (Davis et al. 2008; Gardiner et al. 2018; Moron et al. 2017; Moron et al. 2014; Twerd et al. 2021; Villemey et al. 2018; Wrzesień and Denisow 2016). In areas where railway and public road rights-of-way provide the predominant habitat for pollinators, rights-of-way may act as an ecological trap, concentrating populations in these habitats and making them more susceptible to disturbance (Gardiner et al. 2018). Such habitats could contain different plant species pollinating throughout the season for SLF control activities and pesticide treatments.

In 2014, a Presidential Memorandum was signed that created a federal strategy to promote the health of honeybees and other pollinators. A product of the memorandum was to create a pollinator health task force and develop a document entitled "National Strategy to Promote the Health of Honeybees and other Pollinators". The memo also directed USEPA to work with state agencies to develop pollinator protection plans. Prior SLF EAs summarize the availability of pollinator protection plans for States within the Program area. Indiana, Massachusetts, and Michigan have developed various pollinator protection plans; Rhode Island has a pollinator working group enacted by the State's General Assembly that makes findings and recommendations with regard to maintaining, protection and enhancing pollinator habitat and health in the state (RI DEM 2022):

- Indiana (Indiana Pollinator Protection Plan 2018, https://oisc.purdue.edu/pesticide/p3/p3_final_053118.pdf (OIST 2018))
- Massachusetts Pollinator Protection Plan, https://www.mass.gov/doc/massachusetts-pollinator-protection-plan/download (MDAR n.d.)
- Michigan Managed Pollinator Protection Plan, https://www.michigan.gov/-/media/Project/Websites/mdard/documents/pesticide-plant-pest/pesticide/communication_strategies_for_reducing_pesticide_risk_for_managed_pollinators_in_michigan.pdf?rev=d7f2db4a7e80454bb33a2b2cd4206ef7 (MSU et al. n.d.)

Most of the protection measures described in these plans refer to protection of honeybees but some of the measures may also provide protection for native pollinators. APHIS will follow these best management practices, where applicable and feasible, for protecting honeybees and native pollinators from SLF Program insecticide applications. USEPA (2017) has also developed labeling recommendations focusing on the protection of acute risks to honeybees in managed areas that may have some applicability to native pollinators Many of the measures USEPA describes refer to avoiding applications in and around plant blooming. Doing this can be difficult for non-agricultural pesticide applications (like those made by the SLF Program) due to variability in blooming times for the diversity of plant species that occur in railroad and public road rights-of-way and adjacent natural habitats.

The SLF Program uses risk reduction measures to reduce impacts to adjacent habitats that support pollinators from Program activities occurring in rights-of-way. Wind speed restrictions during applications will reduce drift that may pose a risk to off-site pollinators. Applying insecticides in the evening, when fewer pollinators will be foraging, may provide some level of protection; however, the SLF Program has limited flexibility regarding treatment times. Treatment times along rail rights-of-way are mainly determined by railway availability. In addition, the Program's mist blower and high-pressure hydraulic spray application insecticides have residual toxicity lasting greater than 24 hours so this mitigation measure may not be as effective as other measures in reducing risk to pollinators, especially those that are foraging within the treatment areas. Limiting the number of treatments applied to no more than four treatments per year could reduce risks to pollinators at the Program treatment sites and adjacent off-site areas.

Another measure designed to protect pollinators is the Monarch Candidate Conservation Agreement with Assurances (CCAA) that was developed by the U.S. Fish and Wildlife Service (USFWS) and dozens of entities from the energy and transportation sectors (Cardno, Inc. 2020). The CCAA encourages transportation and energy partners to participate in Monarch butterfly conservation by protecting habitat in rights-of-way and associated lands in the lower 48 states. More than 45 energy and transmission companies and state departments of transportation provide funding and other resources for Monarch-friendly management practices on millions of acres in rights-of-way in the United States. These efforts not only benefit the Monarch butterfly but other native pollinators as well. (USFWS maintains the Monarch butterfly conservation database that tracks ongoing and proposed projects (USFWS 2022). Indiana, Massachusetts, Michigan, and Rhode Island have at least one Monarch butterfly conservation project planned or in progress. APHIS will work with stakeholders to identify locations of Monarch butterfly conservation projects so that the SLF Program's mist blower and high-pressure hydraulic spray treatments do not result in significant impacts due to off-site drift and runoff.

Migratory Bird Treaty Act

Federal law prohibits an individual to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird (16 USC §§ 703-712; 50 CFR § 21).

Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," directs Federal agencies taking actions with a measurable negative effect on migratory bird populations to develop and implement a memorandum of understanding (MOU) with the USFWS which promotes the conservation of migratory bird populations. On May 6, 2022, an MOU between APHIS and the USFWS was signed to facilitate the implementation of this Executive Order (USDA APHIS and USFWS 2022).

Some examples of anticipated disturbance associated with Program activities include the use of off-road vehicles and noise. However, some of the treatment areas, particularly those along rail and public road rights-of-way are subject to train noise, vehicular traffic, and human activity indicating Program control activities in these areas would not likely cause additional disturbance. Beta-cyfluthrin is considered practically non-toxic to birds based on available acute, sub-acute, and chronic toxicity values (USEPA 2013). Bifenthrin is considered slightly toxic to birds based on oral and dietary short-term toxicity testing (USEPA 2010a). Chronic toxicity to birds from both pyrethroid insecticides is considered low based on available data. The toxicity profiles and use patterns for the herbicides, soybean oil, *B. bassiana*, dichlorvos, dinotefuran, and imidacloprid indicate low risk to migratory birds.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668–668c) prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. During their breeding season, bald eagles are sensitive to a variety of human activities. The USFWS recommends buffer zones from active nests which require different levels of protection (USFWS 2007). They are as follows:

1. Avoid clearcutting or removal of overstory trees within 330 feet of a nest at any time. (It should be noted that clearcutting will not be used under any alternative discussed in this document.)
2. Avoid timber harvesting operations (including road construction, and chain saw and yarding operations) during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular

territory—

- including nests that were attended during the current breeding season but not used to raise young, and
- after eggs laid in another nest within the territory have hatched.

If bald or golden eagles are discovered near a Program action area, the state agency responsible for the area will contact the USFWS and implement recommendations for avoiding disturbance at nest sites. For bald eagles, APHIS will follow guidance as provided in the National Bald Eagle Management Guidelines (USFWS 2007) to determine if they need to use the 330 to 660-foot buffer from an active nest, depending on the visibility and level of activity near the nest, or if they will need a permit to proceed with activities and in accordance with Federal law.

Endangered Species Act

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require federal agencies to ensure that their actions are not likely to jeopardize the continued existence of federally listed T&E species or result in the destruction or adverse modification of critical habitat. APHIS initiated or reinitiated consultation with USFWS regional offices in the Program area, including the previous Program area as well as the 4 additional states, for actions proposed under this EA's Preferred Alternative. Federally listed species in the potential SLF Program area include mammals, birds, amphibians, reptiles, fish, mussels, arthropods, and plants. APHIS also reinitiated consultation with the National Marine Fisheries Service (NMFS) regarding sites within NMFS jurisdiction. APHIS will implement protection measures for federally listed T&E species and critical habitat in each state prior to the initiation of Program activities. No SLF Program activities will occur at proposed action sites until consultation has been completed with the USFWS and NMFS.

The SLF Program will implement a minimum 500-foot no-treatment buffer adjacent to aquatic habitats occupied by federally listed T&E species to reduce the potential of off-site runoff and drift of bifenthrin and beta-cyfluthrin insecticides applied using a ground-based mist blower and high-pressure hydraulic spray applications. This buffer and other previously discussed mitigation measures designed to reduce exposure from drift should be adequate based on the results of the screening level aquatic risk assessment prepared by APHIS (see appendix A).

5. Human Health and Safety

Some people, particularly SLF Program workers, may be impacted by the Program's application of herbicides and insecticides. APHIS evaluated the potential human health risks of the herbicides triclopyr, imazapyr, and metsulfuron-methyl used in the Asian Longhorned Beetle

Eradication Program and found those risks to be low. The same human health risks would apply to the SLF Program (USDA APHIS 2015). For a complete assessment of the risks to human health from the application of triclopyr, imazapyr, and metsulfuron-methyl, see the ALB 2015 EIS (USDA APHIS 2015). Human health risks would also be low from the use of glyphosate and aminopyralid, based on risk assessments prepared by the U.S. Forest Service. These risk assessments consider chemical use patterns similar to those in the SLF Program (USDA FS 2007; 2011a).

SLF Program insecticides must be applied in a way that minimizes significant exposure to soil, water, air, and vegetation, to minimize exposure risks. Human health risks from Program insecticides applied via trunk injection, hand-held spray, and backpack spraying are expected to be negligible based on limited exposure from the prescribed use patterns. APHIS evaluated the human health risks for dichlorvos used in the Agency's exotic fruit fly traps and finds the same human health risks will apply to the SLF Program traps (USDA APHIS 2017). Dichlorvos can be toxic to humans (USEPA 2006). Technical dichlorvos has high acute toxicity (Category I) via dermal exposure, and moderate acute toxicity (Category II) from oral and inhalation exposures (USEPA 2006). However, exposure of the public to dichlorvos is negligible due to public notification about SLF control activities and the method of application, which eliminates off-site movement of dichlorvos from drift or runoff. Volatilization of dichlorvos from the trap occurs, but the potential for inhalation exposure is low due to the small quantities used in each trap and the outdoor placement of the traps. Trap placement is above the normal reach of children. If traps were accidently dislodged, there could be potential exposure mainly via dermal contact and incidental ingestion through hand-to-mouth contact with the dichlorvos-treated strip. The SLF Program does not allow commodities to be harvested from treated trees, minimizing potential dietary risks to humans.

B. bassiana, soybean oil, and dinotefuran are of low toxicity to humans. Imidacloprid has increased risks, but treatments are limited to injections on trap trees, so risk exposures are minimized. Bifenthrin has low acute toxicity via the dermal route of exposure, moderate acute toxicity via the oral route, and is considered a possible human carcinogen (USEPA 2020i). Low amounts of bifenthrin can cause adverse human health effects, including dermal and respiratory tract irritation and neurological symptoms (e.g., dizziness and altered sensations) (USEPA 2010a). Beta-cyfluthrin has high oral and inhalation toxicity.

The use of mist blowers and high-pressure hydraulic spray treatments to apply bifenthrin and beta-cyfluthrin poses the greatest risks to humans when compared to other program actions. Workers applying pesticides as well as the public in areas that are in proximity to treatment sites, may be exposed. APHIS personnel and contractors are required to comply with all USEPA pesticide label use requirements and meet all recommendations for PPE during insecticide application. Adherence to label requirements and additional SLF Program measures (listed below) designed to reduce exposure to workers (e.g., PPE requirements include wearing a long-sleeved shirt, long pants, and shoes plus socks) and the public (e.g., mitigations to protect water sources, mitigations to limit spray drift, and restricted-entry intervals) will decrease risk of exposure.

Pesticide drift and runoff increase potential exposure to the public around treatment areas. To ensure minimal impacts to those in proximity to mist blower and high-pressure hydraulic spray treatment areas, it is extremely important to adhere to label mitigations. In addition, the following previously mentioned restrictions will be applied whenever using mist blowers/hydraulic spray treatments, which will decrease risks:

- Do not apply when wind direction favors downwind drift towards nearby water bodies.
- Do not apply when wind velocity exceeds 5 mph.
- Do not treat areas to the point of run-off.
- Do not make applications during rain.

To further protect the public, any activities on private property will only occur with property owner and/or resident permission and awareness. Notification of all property owners and residents will occur within 1 mile of the treatment area in the following manner: in person, phone call, text, email, doorhanger, or a combination of these methods. It is possible that the SLF Program can adjust the treatment time, so applications are made when few or no people are in the vicinity. However, this mitigation will need to be done on a case-by-case basis. The SLF Program must work with the various railroad companies to obtain access to the railroads; therefore, treatment dates and times are not necessarily determined by the Program.

Pesticide Hypersensitivity

Applications with mist blowers and high-pressure hydraulic sprays, which spread droplets of insecticide further than the other application methods in the SLF Program, have the potential to impact surrounding individuals that have pesticide hypersensitivity. Additional buffers may be necessary to protect these individuals. The SLF Program standard protocol to notify all property owners and/or residents within one mile of the treatment area will also allow any pesticide hypersensitive individuals to contact the Program and/or take any protective measures necessary to protect themselves from nearby pesticide treatments. The SLF Program will use available State data to locate pesticide hypersensitive individuals so they can adjust where pesticides are being sprayed and notify these people and their businesses.

Pesticide application businesses are required to notify individuals in the registry in advance of pesticide application that are within a certain distance on an adjacent property. For example, The Michigan Department of Agriculture and Rural Development maintains a pesticide notification registry (https://www.michigan.gov/mdard/licensing/pesticide/notification (MARD 2022)), which has a physician-recommended distance of not more than 100 feet from a linear boundary line. Information on similar registries in Indiana, Massachusetts and Rhode Island were not readily available online. If no information is available online, the SLF Program will contact the State's environmental protection agency or agriculture agency. The SLF Program will comply with all state, county, and local ordinances and authorities when providing notifications to address the needs of any surrounding pesticide hypersensitive individuals.

6. Commercial Organic Production and Beekeeping

Organic Production

The control of SLF around organic fields is important, while traditional orchards and vineyards have various options for chemically treating trees and grape vines against SLF, effective treatment options for organic producers are minimal. *B. bassiana* is allowed for use by USDA as an organic pesticide (AgDaily 2019) and 7 CFR part 205, National Organic Program) and has been shown to be effective against SLF (Clifton et al. 2020).

In 2019, the number of certified organic farms in Indiana, Massachusetts, Michigan, and Rhode Island was 595, 133, 541, and 20, respectively (USDA NASS 2019). The prior SLF EAs summarize organic production information for the other states in the Program area. To protect organic production in the treatment area, the SLF Program must follow all labeled requirements that attempt to ensure the reduction of spray drift and runoff of the pyrethroids into organic fields, including using the appropriate nozzle size, buffers, and not applying when wind direction or velocity is not ideal. Even with all prescribed measures, drift onto organic fields could still occur, so the Program will notify organic producers within one mile of a treatment area prior to any SLF mist blower and high-pressure hydraulic spray treatments. The Program provides notifications through state level registries, local media, and/or at association meetings with organic or apiary associations. Delaware, District of Columbia, Indiana, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Virginia, and West Virginia endorse the use of the online registry FieldWatch® (https://fieldwatch.com/fieldwatch-state-registries/ (FieldWatch 2022)). The registry is free and voluntary. Pesticide and herbicide applicators can notify growers (and beekeepers) of spray applications through the system.

Apiaries

The SLF Program must protect local apiaries from chemical exposure within treatment areas. The location and timing of bifenthrin and beta-cyfluthrin applications are of particular concern to honeybees; both insecticides are toxic to pollinators and the use of mist blowers and high-pressure hydraulic spray treatments may result in insecticide drift. In 2021, the number of bee colonies reported in Indiana, Massachusetts, and Michigan 10,000, 5,000, and 78,000; the number of bee colonies for Rhode Island was not published in the dataset (USDA NASS 2022). Bee colony information for the other states in the Program area is covered in prior SLF EAs. Indiana and Michigan do not require apiary registration but have voluntary registration of apiaries using BeeCheck^{TM}, a system that facilitates communication between beekeepers, agricultural producers, and pesticide applicators (see https://beecheck.org/map) (IN DNR 2022)). The SLF Program will work with the State Agriculture Departments to notify beekeepers of treatment activities, especially those beekeepers located within 1-mile of a treatment site where mist blower and high-pressure hydraulic spray treatments will be used. The Program also provides notifications of Program treatments using online apiary registration sites, local media, at apiary association meetings.

Bifenthrin kill bees on contact during application and will continue to kill bees for one or more days after treatment (Krupke et al. 2021). Beta-cyfluthrin product labels state that applications made directly to crops or weeds are highly toxic to pollinators, such as bees. The label also states not to make applications or allow drift to crops or weeds where bees are actively foraging. Various plant species may occur in the use sites proposed for SLF treatments; blooming may occur at different times throughout the treatment season for SLF. These sites will be evaluated prior to application to determine if bees and other pollinators are actively foraging. Per label requirements, applications will be avoided at sites where pollinators are foraging, or when conditions are favorable for drift to areas where pollinators are foraging.

The Program will consider chemically treating with hand-held or backpack sprayers when treatment areas are within proximity to apiaries. If not possible to spray with hand-held or backpack sprayers, bees should be moved from the area if bifenthrin or beta-cyfluthrin are used on plants the bees are visiting. A new site must be at least 3 miles away to prevent bees from returning to the old site (Krupke et al. 2021). Applying insecticides in the evening, when fewer bees will be foraging, will also provide some protection to honeybees. However, the SLF Program has limited flexibility regarding treatment times; for example, treatment times along rail lines are mainly determined by railway availability.

7. Equity and Underserved Communities

In Executive Order (EO) 13985, *Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*, each agency must assess whether, and to what extent, its programs and policies perpetuate systemic barriers to opportunities and benefits for people of color and other underserved groups. In EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Federal agencies must identify and address disproportionately high and adverse human health or environmental impacts of proposed activities. Federal agencies also comply with EO 13045, *Protection of*

Children from Environmental Health Risks and Safety Risks. This EO requires each federal agency, consistent with its mission, to identify and assess environmental health and safety risks that may disproportionately affect children and to ensure its policies, programs, activities, and standards address the potential for disproportionate risks to children.

Under the Preferred Alternative, the SLF Program expects a possible increase in the number of treatment areas along railways and public road rights-of-way. Table 4 summarizes the distance covered by rail and public roads in Indiana, Massachusetts, Michigan, and Rhode Island; a subset of the rail and road rights-of-way in the Program area. While homes near commuter train stations tend to get more expensive, general online comments indicate home values tend to be less by railways due to noise, dangers surrounding pets and children being hit by trains, and diesel fuel and air pollution. A study in Memphis, Tennessee indicated residential properties exposed to 65 decibels or greater of railroad noise origin resulted in a 14 to 18 percent lower property value (Walker 2016). It is reasonable to assume underserved populations may be more prevalent around certain railways and public road rights-of way (Boehmer et al. 2013), and this needs to be considered during SLF treatments. A study by the Mayo Clinic connects existing health issues for populations near railways, specifically increases in children's asthma along railroads (Juhn et al. 2005). Similarly, studies indicate populations near major roads experience adverse health effects (Boehmer et al. 2013; McConnell et al. 2006).

According to EO 13985, SLF Program personnel must have meaningful engagement with locally impacted people whenever possible. APHIS utilizes various databases and mapping tools to identify the locations of underserved populations in the Program area. APHIS has relied on the USEPA environmental justice screening and mapping tool, EJSCREEN (see https://www.epa.gov/ejscreen), which can highlight areas that may require additional thought, research, and outreach regarding Program activities. EJSCREEN users choose a geographic area; the tool then provides demographic and environmental information for that area. The six demographic criteria that EJSCREEN uses to identify underserved populations include: percent low income, percent people of color, less than high school education, linguistic isolation, individuals under age 5, individuals over age 64. It must be noted that while EJSCREEN is very informative, there are substantial uncertainties in demographic and environmental data. Results should be supplemented with local knowledge. Using EJSCREEN, APHIS identified the states in the Program area have areas of concern for potential environmental impacts to underserved populations. Special consideration needs to be given when outreach to these communities begins.

EJSCREEN can provide more detailed information, down to residential blocks, but more meaning files are difficult to share. Other databases that APHIS uses provide detailed maps that may be more meaningful to the public, such as one developed by the Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) using the Social Vulnerability Index (SVI) (see https://www.atsdr.cdc.gov/placeandhealth/svi/index.html). Social vulnerability refers to the potential negative effects on communities caused by external stresses on human health. CDC's SVI uses 15 social factors that are grouped into 4 major themes including socioeconomic status, household composition and disability, minority status and language, and housing type and transportation. Like EJSCREEN, maps generated by the CDC's SVI database can highlight areas that may require additional thought, research, and outreach regarding Program activities.

With APHIS' oversight and guidance, State and local agencies will reach out to all landowners and residents adjacent to spraying areas. Every property owner and resident, regardless of whether they have been identified as being part of an underserved population, will be notified via phone, text, email, doorhanger, in person communication, or some combination of these methods. With the assistance of local authorities, special consideration will be given by the SLF Program to any underserved populations in Program treatment areas to ensure meaningful engagement about the treatments occurs.

Protective measures on pesticide labels are meant to safeguard not only the applicator, but the public as well, including children. All Program pesticide labels will be followed. Previously mentioned restrictions, such as limiting applications when wind speed is above 5 mph, limiting applications due to wind direction, not treating vegetation to the point of runoff, will all decrease potential exposure of underserved communities and children through drift and runoff. The Program is aware that schools may be located within one-half mile from where mist blowers and high-pressure hydraulic spray treatments could be used. There will also be playgrounds and parks within proximity to areas treated with mist blowers and high-pressure hydraulic spray treatments. The use of mist blowers and high-pressure hydraulic treatments to spray bifenthrin and beta-cyfluthrin pose the greatest potential impact to children. It would be preferrable for the Program to chemically treat with hand-held or backpack sprayers when treatment areas are within proximity to schools, parks, and playgrounds.

Treatments will primarily be during summer months when most school children are not on school grounds. Regardless of application method or when treatments occur, the SLF Program will not apply pesticides during school hours and will notify all schools regarding upcoming applications. The SLF Program will work closely with school officials to mitigate impacts to school aged children. The SLF Program will work with ground staff and city/municipal authorities prior to treatments at parks to limit access to treated areas or schedule applications during off-hours. Sections of park may require closures.

8. Tribal Consultation and Coordination

Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," calls for agency communication and collaboration with Tribal officials for proposed federal actions with potential Tribal implications. The Archaeological Resources Protection Act of 1979 (16 USC §§ 470aa-mm) secures the protection of archaeological resources and sites on public and Tribal lands. APHIS provides each federally recognized Tribe in this EAs' geographic scope with a letter explaining the preparation of the EA, detailing the action alternatives, and stating that the Agency believed the preferred alternative is unlikely to affect Native American sites and artifacts. Tribes are provided with APHIS contact information should they have any questions or concerns regarding the SLF Program. The most recent letter APHIS sent was on August 18, 2021. Letters are being prepared for Tribes with landholdings in the four additional states in the expanded SLF Program area.

APHIS hosted a webinar on January 23, 2023, with interested Tribes concerning the previous SLF Program in ten states and the District of Columbia. The intent of the webinar was to explain the SLF program and allow input from any potentially affected Tribes. A recording of the webinar is available for Tribes to view upon request. APHIS offers each Tribe the opportunity to consult with the Agency. Consultation with local Tribal representatives occurs prior to the onset of SLF Program activities, to fully inform the Tribes of possible actions the Agency may take on or near Tribal lands. If APHIS discovers any archaeological Tribal resources in a Program area, it will notify the appropriate authorities.

9. Historic and Cultural Resources

The National Historic Preservation Act of 1966, as amended (16 United States Code (USC) §§ 470 et seq.), requires federal agencies to consider the potential for impacts to properties included in, or eligible for inclusion in the National Register of Historic Places (36 CFR §§ 63 and 800) through consultation with interested parties where an Agency action may occur. This includes districts, buildings, structures, sites, objects, and landscapes. Prior SLF EAs summarize historic properties in the Program area. Here we provide information on historic properties for the 4 states the Program will add to the Program area. There are 2070, 4452, 1994, and 813 historic properties in Indiana, Massachusetts, Michigan, and Rhode Island, respectively (NPS 2022). APHIS will ensure that the preferred alternative will not alter, change, modify, relocate, abandon, or destroy any historic buildings, edifices, or nearby infrastructure. Certain insecticidal oils can stain dark-colored house paints (Cranshaw and Baxendale 2013) and high-pressure water may not be recommended for some surfaces. APHIS anticipates that herbicides and insecticides applied in the vicinity of historic buildings and other anticipated program actions will not directly affect the buildings or their properties. The Program may apply bifenthrin and beta-cyfluthrin to the exterior surface of buildings within 3 feet above grade, according to label instructions. However, the Program's application of pesticides to buildings would be at locations identified as high risk for human-mediated movement of SLF, e.g., truck depots, rail yards, etc., not to public, residential, or commercial buildings. The Program would not treat buildings or structures on the historic registry with insecticides or high-pressure water treatments. The Program would only make treatments on historic properties with the pre-approval from the State Historic Preservation Officer.

B. No Treatment Alternative

APHIS will not provide funding for SLF control under the no treatment alternative. APHIS will not apply herbicides, use insecticide treatments, use SLF traps, or conduct surveys under this alternative. Other government agencies and private landowners may work to control SLF; however, there will be no cooperative or coordinated efforts among APHIS and other stakeholders. State and local government agencies and private landowners may implement control measures.

SLF will most likely become established in more areas than under the no action and preferred alternatives and impacts from SLF will become widespread over the long-term. Stress induced by SLF damage could predispose hosts to invasion by other pests and infections by pathogens. Impacts will occur wherever SLF hosts grow, such as urban plantings, orchards, vineyards, and forested areas. The environmental impacts associated with the death of SLF hosts will vary with the intensity of SLF infestation at each site.

In natural ecosystems, reduced growth or the loss of SLF host trees will create canopy gaps, possibly leading to increased establishment of invasive plants, particularly other shade-intolerant vegetation (USDA APHIS 2018). Ecosystem impacts from SLF infestation are likely to be similar to impacts from other causes of tree mortality, which are known to include changes to forest composition, structure, and microenvironments; alterations to ecosystem processes such as nutrient cycling and retention; and increased ecosystem susceptibility to invasion by exotic plants and animals (Orwig 2002). The vitality of host tree spp. is likely to be reduced, but the level of tree mortality remains unknown. To date, the invasive potential of *A. altissima* does not appear to be reduced by the presence of SLF.

Historically, outbreaks of introduced pests and pathogens led to shifts in harvesting strategies of host trees (Orwig 2002). For SLF, the presence of an invasive tree host serving as a reservoir for infestations to agricultural crops poses the greatest risk for agroecosystem functioning. Industries relying on a particular tree species could suffer indirectly. SLF infestation of maple trees, for example, could lead to lower availability of tree pollen (honeybee forage), sap (for sugar and syrup), wood (for furniture, flooring, musical instruments, sports equipment, paper, etc.), and visual resources (landscaping, seasonal tourism).

SLF-host orchard crops, vineyards, and urban trees could sustain damage to the point of needing replanting. Although plant removal in orchards and vineyards regularly occurs as producers replace less productive plants over time, SLF infestation could increase the rate of replacement if existing trees and vines are not chemically treated. Development of resistant stone fruit tree or grape varieties also will take time and may force producers to incur these costs prematurely (Woodcock et al. 2018).

It is expected that fewer chemical treatments will occur by State and local government agencies and private landowners than by APHIS under the no action and preferred alternatives, so there is the potential for fewer impacts from these chemicals to the physical environment (air, water, and soil). However, there is a small chance States and private groups could apply pesticides, some of which may have environmental impacts that could be greater than those pesticides prescribed for Program use in the No Action and Preferred Alternative.

C. No Action Alternative

Under the no action alternative, APHIS will not make changes to the current SLF Program as described in the October 2021 supplemental EA titled “Spotted Lanternfly Control Program in the Mid-Atlantic Region, North Carolina, Ohio, and Kentucky” available online at https://www.aphis.usda.gov/plant_health/ea/downloads/2021/supplemental-slf-mid-atlantic-october-2021.pdf (USDA APHIS 2021) and in section II of this EA. The Program’s area would not expand to include the states of Indiana, Massachusetts, Michigan, and Rhode Island. The Program would not expand the use of bifenthrin and beta-cyfluthrin to include all rail and road rights-of-way. The Program would not include the use of high-pressure water to remove SLF egg masses from *Ailanthus* trees and inanimate objects and equipment. The environmental consequences for the no action alternative in this EA are equivalent to the environmental consequences for the preferred alternative in the October 2021 supplemental EA.

To summarize the findings in the October 2021 supplemental EA, impacts to the environment and human health were and still are minimal under this alternative. Urban areas are expected to experience incrementally minor impacts to environmental quality in comparison to other activities, such as residential and business development that increases impervious surfaces and allows transport of a variety of pollutants to surface and ground water. Use of herbicides and insecticides is minimal and use methods are very controlled, therefore, minimal impacts are expected. Potential impacts associated with *A. altissima* control will be small, local, and short-term.

The no action alternative will continue to reduce SLF populations within the Program’s area and will slow the spread of SLF into new areas. Not expanding the SLF program to include Indiana, Massachusetts, Michigan, and Rhode Island, where the insect now occurs, will result in the SLF population to increase, and spread into non-infested areas within and beyond those states. SLF impacts in these four states will be like the impacts described under the no treatment alternative, because APHIS would not add these states to the Program area. Impacts will occur wherever SLF hosts grow, such as urban plantings, orchards, vineyards, and forested areas. The environmental impacts associated with the death of SLF hosts will vary with the intensity of SLF infestation at each site. The Program's goal is to control SLF outbreaks and slow down its spread, and not expanding the Program's action area to include these four states and expand treatment sites to include rail and road rights-of-way prevents the Program from reducing SLF's spread and impact.

The amount of pesticide used in the Program may increase within its current action area, but the increase would not result from the Program expanding the action area to include these four states and rail and road rights-of-way. State and federal counterparts, growers, and individuals in these four states may potentially apply insecticide treatments to control SLF. Without Program oversight, it is possible that more and/or different insecticide treatments would occur.

D. Comparison of Three Alternatives

While APHIS will not take actions against SLF under the no treatment alternative, or in Indiana, Massachusetts, Michigan, and Rhode Island under the no action alternative, other government agencies and private landowners may act. Under the no treatment and no action alternative, it is possible that environmental impacts could increase if actions taken by others are not well advised or properly coordinated. Additionally, not expanding the treatment use sites to include rail and road rights-of-way may decrease APHIS ability to slow the spread of SLF. Under the no action and no treatment alternatives, impacts from SLF damage on host trees, orchards, vineyards, and forests, are expected to increase compared to the preferred alternative.

The preferred alternative will expand Program treatment options and increase the level of human activities around treatment areas in the four states, as well as in the current Program area, which can, to varying degrees, impact ground vegetation, soil compactions, and noise levels. By utilizing best management practices, APHIS can minimize these impacts on humans and the environment.

Under the preferred alternative, there are thousands of miles of railways and public road rights-of-way that could potentially be treated with bifenthrin or beta-cyfluthrin using mist blowers and high-pressure hydraulic spray treatments. APHIS acknowledges that only a fraction of the rail and road miles would be treated; the Program focuses treatments on rights-of-way that are considered high risk for human-mediated movement of SLF.

There are various places of concern that may be in proximity to treatment areas, everything from waterbodies and wetlands, public land use areas, schools, organic producers, homes, honeybee hives, and historic properties. Spray drift and runoff into these areas must be minimized to protect air, water, soil quality; human health; and wildlife. If mist blowers and high-pressure hydraulic spray treatments are used per the pesticide label, with all the additional protective mitigations described throughout the document, impacts to soil, water, and air quality are not expected to be significant. Soil disturbance related to program activities will be short-term.

Several potential treatment areas are highly managed and disturbed habitats that receive routine railway and vehicular traffic and other mechanical and chemical treatments to manage unwanted vegetation. Current and future activities related to urbanization, agricultural activities, logging, and roadway construction appear more likely to significantly impact environmental quality than the program.

Vehicle emissions associated with getting to and from project sites will be minor relative to the ongoing and future emissions from urbanization, highway traffic, and agricultural production. Any increases in air pollutants associated with program activities and vehicle emissions will cease upon completion of program activities at each site. The contribution from the preferred alternative will remain minor compared to the overall emissions in the program area.

APHIS expects the potential human health impacts related to the preferred alternative to be minimal, and in the context of potential cumulative impacts to past, present, and future activities, these impacts will be incrementally minor. The greatest sector of the human population at risk of exposure to herbicides and insecticides are program workers and applicators; however, these risks are minimized with PPE.

To preserve environmental quality for ecological resources, potentially negative cumulative impacts are minimized throughout the preferred alternative by following best management practices and training personnel to reduce or avoid adverse impacts to pollinators, eagles, migratory birds, T&E species, and the surrounding environment.

Table 6 summarizes the potential human health and environmental impacts from each of the three alternatives for a quick comparison.

Table 7. Comparison of potential human health and environmental impacts.

Control Measure	No Action	No Treatment	Preferred
Herbicides	Minimal impact to human health and environment if labels are followed.	Potentially less use of herbicides than no action and preferred alternative and less impacts.	Identical to the no action. Minimal impact to human health and environment if labels are followed.
Insecticides	Soybean oil and *B. bassiana* – extremely low potential for human health and environmental impacts. Dinotefuran and imidacloprid – method of application keeps human health and environmental impacts to a minimum. Bifenthrin and beta-cyfluthrin – potential for human and environmental toxicity issues. Minimal impacts if products are used according to label and Program mitigations.	Potentially less use of insecticides than no action and preferred alternative and less impacts.	The impacts from soybean oil, *B bassiana*, dinotefuran, and imidacloprid are the same as under the no action alternative. The impacts from bifenthrin and beta-cyfluthrin may be greater than under the no action alternative due to the potential increase in areas that may be treated. Increase in potential human health and environmental impacts and impacts to pollinators due to use of mist blowers and high-pressure hydraulic spray treatments. Impacts will be reduced if labels followed and additional buffer to waterbodies is used
Traps	Extremely low impact to human health and environment.	Potentially even less impacts than no action since use of fewer traps is anticipated.	Identical to no action. Extremely low impact to human health and environment.

Control Measure	No Action	No Treatment	Preferred
Surveys and Egg Mass Scraping	Extremely low impact to human health and environment.	Potentially less impacts than no action since there may be less use of surveys and no egg scraping.	Identical to no action. Extremely low impact to human health and environment.
High pressure-water treatment	This treatment is not part of the no action alternative. No impacts to human health or the environment other than viable SLF eggs remaining in the area.	This treatment is not part of the no treatment alternative. No impacts to human health or the environment other than viable SLF eggs remaining in the area.	This treatment does not have impacts to human health or the environment. The treatment is expected to reduce viable SLF eggs, reducing the population.

IV. Listing of Agencies Consulted

State Agencies

Connecticut Department of Agriculture
450 Columbus Boulevard, Suite 701
Hartford, CT 06103

Delaware Department of Agriculture
2320 S. Dupont Highway
Dover, DE 19901

Maryland Department of Agriculture
50 Harry S. Truman Parkway
Annapolis, MD 21401

New Jersey Department of Agriculture
200 Riverview Plaza - 3rd Floor
Trenton, NJ 08611

New York Department of Agriculture & Markets
10B Airline Drive
Albany, New York 12235

North Carolina Department of Agriculture
2 West Edenton Street
Raleigh, NC 27601

Ohio Department of Agriculture
8995 East Main Street
Reynoldsburg, OH 43068

Pennsylvania Department of Agriculture Bureau of Plant Industry
2301 North Cameron Street
Harrisburg PA 17110

Virginia Department of Agriculture & Consumer Services
102 Governor Street
Richmond, Virginia 23219

West Virginia Department of Agriculture
1900 Kanawha Boulevard
East State Capitol, Room E-28
Charleston, WV 25305

USDA

Environmental & Risk Analysis Services
USDA-APHIS-PPD
4700 River Road, Unit 149
Riverdale, MD 20737

Plant Health Programs
USDA-APHIS-PPQ
4700 River Road, Unit 150
Riverdale, MD 20737

USDOC- NMFS

National Marine Fisheries Service, Office of Protected Resources
510 Desmond Drive SE, Suite 103
Lacey, WA 98503

USDOE-USFWS

U.S. Fish & Wildlife Service, Indiana Office
620 South Walker Street
Bloomington, IN 47403

U.S. Fish & Wildlife Service, Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

U.S. Fish & Wildlife Service (for MA and RI)
70 Commercial Street, Suite 300
Concord, NH 03301

U.S. Fish and Wildlife Service, Michigan Office
2651 Coolidge Road, #101
East Lansing, MI 48823

U.S. Fish and Wildlife Service, New Jersey Field Office
4 E. Jimmie Leeds Road, Suite 4
Galloway, NJ 08205

U.S. Fish and Wildlife Service, Ohio Ecological Services Field Office
4625 Morse Road
Columbus, OH 43230

U.S. Fish and Wildlife Service Pennsylvania Field Office 110 Radnor Road, Suite 101
State College, PA 16801

U.S. Fish and Wildlife Service, Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

U.S. Fish and Wildlife Service West Virginia Ecological Services Field Office
90 Vance Drive
Elkins, WV 26241

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Appendix A. Aquatic ecological risk assessment for the application of bifenthrin and β-cyfluthrin using ground-based mist blower and high-pressure hydraulic treatments for spotted lanternfly.

Introduction

The purpose of this risk assessment is to evaluate the risk to aquatic resources from the use of bifenthrin and betacycluthrin (β-cyfluthrin) using ground-based mist blower or high-pressure hydraulic applications to treat for the spotted lanternfly (SLF), *Lycorma delicatula*. Applications are proposed along railway rights of way, road and highway rights of way, airports, seaports, train yards, distribution centers, and intermodal facilities. USDA-APHIS is proposing a 150-foot (ft.) no-application buffer from all waterbodies within the proposed action area to protect human health and ecological resources from the risk of either insecticide. Waterbodies include, but are not limited to lakes, reservoirs, rivers, permanent streams, wetlands, natural and manmade ponds, and estuaries. USDA-APHIS is also proposing a 500-ft. no-application buffer from habitat, including designated critical habitat, for all federally listed aquatic species that may occur within the proposed action area.

This risk assessment evaluates how the USDA-APHIS proposed buffers, other program measures, and label restrictions may impact aquatic resources. The methods used in this risk assessment are consistent with methods used to evaluate the risk of pesticides (USEPA, 1998; USEPA, 2004; USEPA, 2020a).

Exposure Analysis

This section of the risk assessment summarizes the use pattern, environmental fate, and chemistry data for bifenthrin and β-cyfluthrin. This section also estimates environmental residues in aquatic resources that could occur from mist blower and hydraulic spray applications.

Use Pattern

Applications of bifenthrin and β-cyfluthrin will be made using mist blower applications that are intended to create a small droplet size to increase efficacy because the mode of action is primarily as a contact insecticide. Applications using high-pressure hydraulic sprays are ground-based applications onto the bole of the tree and into the canopy using larger droplet size than those that would typically occur using mist blowers. The label for bifenthrin (Talstar® P (EPA Reg. No. 279-3206)), allows treatment rates of 1.0 fluid ounce (fl. oz.) per 1,000 square feet (sq. ft.) or 43.5 fl. oz. per 100 gallons. For bifenthrin the maximum allowable application rate per acre (ac) is 0.22 lb. a.i./ac. with a minimum application interval of 28 days based on the Talstar® P label. The label for β-cyfluthrin (Tempo® SC (EPA Reg. No. 432-1363)) allows a treatment rate of 0.54 fl. oz. per 1,000 sq. ft. For β-cyfluthrin the maximum allowable application rate per acre is approximately

0.183 lb. a.i./ac. with a minimum application interval of seven days. The number of applications that will occur at a site will range from one to four applications for either insecticide dependent upon the density of SLF and resources available for additional applications.

USDA-APHIS will implement the mitigation measures listed below that are either on the label or are proposed as part of the SLF program to reduce the likelihood of drift and runoff to aquatic resources.

- Avoid mist blower and high-pressure hydraulic applications at wind speeds greater than 5 mph.
- Use a 150-ft. no-application buffer from all waterbodies.
- Use a 500-ft. no-application buffer from all waterbodies that are habitat for federally listed aquatic species, including designated critical habitat.
- Avoid applications when rain events are expected within 24 hours prior to application and to saturated soils, where feasible.
- Avoid applications when the predominant wind direction is blowing toward a waterbody.

Treatments for SLF will be made as spot treatments, with the size of the treatment area ranging from 0.5 to 50 acres. The distance of maximum projection from a mist blower is 100 feet vertically, although target SLF vegetation is approximately 30 feet tall. Applications are anticipated to occur at 75% of the actual height of the vegetation due to mist droplets moving up into the top of treated vegetation. The distance of maximum projection from a mist blower is 160 feet horizontally in an open area with no vegetation to intercept spray. Treatments using the pressurized sprayer would reach as high as 30 to 40 feet high in the tree, including the bole and canopy. Operationally, most treatments will be conducted as close as possible to the targeted vegetation with most vegetation within 30 ft. of the railroad track. A maximum of two swaths will be applied along rail lines or roads if vegetation is present on either side. If vegetation is present on only one side of the rail line or road, then only one swath would be applied. The timing of the applications will occur between April and October to coincide with nymphal emergence through the adult stage of SLF.

Chemical and Environmental Fate Properties

Bifenthrin and β-cyfluthrin are pesticides that belong to the pyrethroid insecticide class (figure 1). Pyrethroid insecticides are synthetic analogues of pyrethrins which are derived from flower heads of *Chrysanthemum cinerarieaefolium* and/or *C. cineum* (Spurlock and Lee, 2008). Pyrethroid insecticides act as neurotoxins by reacting with voltage-gated sodium channels in neurons. They have broad spectrum activity against a variety of invertebrate pests resulting in a wide variety of agricultural and non-agricultural use patterns in the United States. Bifenthrin and β-cyfluthrin are registered for various agriculture, commercial structural and landscape, and home and garden use (Spurlock and Lee, 2008).

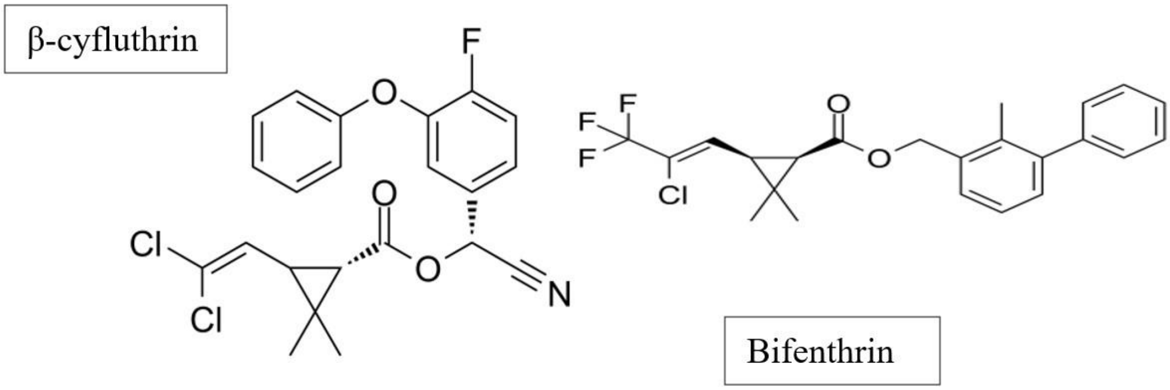

Figure 1. Chemical structure for β-cyfluthrin and bifenthrin.

Bifenthrin and β-cyfluthrin exhibit chemical and fate properties that suggest residues in the aquatic environment will occur primarily in the bound phase to soil particles and organic matter that are transported via runoff, or partition to total suspended solids and sediments from offsite drift into waterbodies (Table 1) (USEPA, 2012; 2016a). Water solubility is low for both insecticides with corresponding high soil adsorption coefficients (Koc) in various soil types. Vapor pressure and Henrys Law constant values suggest that bifenthrin and β-cyfluthrin will not volatilize from soil or water into the atmosphere in significant amounts. Both insecticides have high log-octanol water partition coefficients (Kow) suggesting they are lipophilic and may accumulate in nontarget organisms.

Table 1. Chemical and environmental fate properties for bifenthrin and β-cyfluthrin (USEPA, 2016a).

Chemical Fate Parameter	Bifenthrin	β-cyfluthrin
Molecular weight (g/mole)	422.9	434.29
Vapor pressure (mm Hg)	$1.8x10^{-7}$	$1.5x10^{-8}$
Henry's Law Constant (25°C) Atm*m^3/mole	$7.2x10^{-3}$	$3.7x10^{-6}$
Log-octanol water partition coefficient (log Kow)	6.4	6.2
Solubility (mg/L)	$1.4x10^{-4}$	$2.3x10^{-3}$
Hydrolysis half-life (days)	Stable	Stable at pH 5 and 7; 2.1 at pH 9
Soil photolysis half-life (days)	147 cyclopropyl 98.5 phenyl labels	5.6
Aqueous Photolysis half-life (days)	49	4.5

Chemical Fate Parameter	**Bifenthrin**	**β-cyfluthrin**
Koc (L/kg-organic carbon)	131,000 to 302,000	73,484 to 184,864
Aerobic soil metabolism half-life (days)*	169.2	72.68
Aerobic aquatic metabolism half-life (days)*	466.2	44.58
Anaerobic aquatic metabolism half-life (days)*	650.2	25.59
Foliar half-life (days)	35	Not reported

*Values represent 90th percentile estimates using the following equation: $t_{input} = t_{1/2} + t_{90,\, n-1}s / \sqrt{n}$.

Bifenthrin degradation under anaerobic conditions is comparatively much slower compared to β-cyfluthrin. Laboratory values have been confirmed in an outdoor wetland study where dissipation half-lives for bifenthrin in sediments were reported as 1,733 days, or as stable (Budd et al., 2011). Gan et al. (2005) reported bifenthrin aquatic aerobic and anaerobic half-life values in outdoor stream channels ranging from 436 to 1,950 days, and 251 to 498 days, respectively.

Degradation rates for bifenthrin and β-cyfluthrin typically follow a first-order decay rate, *k* (Meyer et al., 2013):

$$t1/2 = \ln(2)/k$$

Rapid dissipation of bifenthrin and β-cyfluthrin from water to sediments and other sources of organic matter has been measured in various laboratory and field studies in freshwater and marine systems. Pennington et al. (2014) reported a 50% reduction in nominal bifenthrin concentrations one hour after dosing mesocosm tanks simulated to represent a saltwater marsh environment. Bennett et al. (2005) measured dissipation in vegetated freshwater agricultural ditches dosed with bifenthrin. Dissipation appears to be bi-phasic with 98.3% removal of bifenthrin from the water column within 24 hours after dosing, and reductions occurring at a slower rate after 24 hours (figure 2).

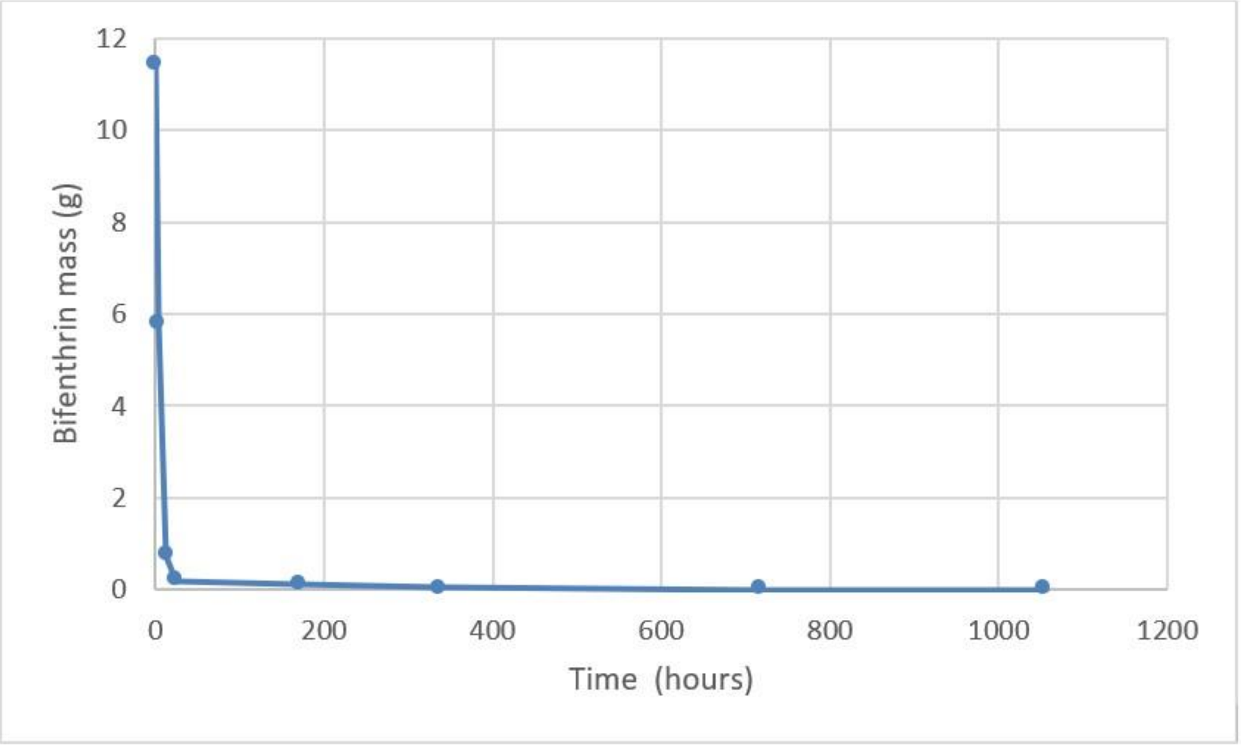

Figure 2. Aquatic dissipation curve for bifenthrin (Bennett et al., 2005).

Similar rapid dissipation in the water column has been observed for cyfluthrin in retention ponds and constructed wetland systems (Moore et al., 2009). Cyfluthrin aquatic dissipation was approximately 93% in retention ponds, and between 91 to 98% in constructed wetlands within 48 hours after dosing. Similar rapid aquatic dissipation rates have been observed in other field studies using other pyrethroid insecticides. Maund et al. (2008) reported dissipation half-lives ranging from less than 0.13 days to 1.2 days in various indoor and outdoor microcosm/mesocosm studies for lambda-cyhalothrin.

Degradation or transformation products of β-cyfluthrin include permethric acid or DCVA (3-(2,2, -dichlorvinyl)-2,2-dimethyl-cyclopropanecarboxylic acid), FPB-ald (4-fluroe-3-phenoxybenzaldehyde), and FPB-acid (4-fluoro-3-phenoxybenzoic acid). DCVA and FPB-acid have low to moderate mobility in soil based on the available range of Koc values (USEPA, 2016a). These metabolites are considered less toxic due to the loss of their neurotoxic mode of action (USEPA, 2016a). Bifenthrin degradation products are minimal due to longer half-lives measured in various laboratory studies.

Estimated Environmental Concentrations in Aquatic Habitats

Off-site transport of insecticides during and after application typically occurs through volatilization, runoff, and drift. Chemical properties for bifenthrin and β-cyfluthrin suggest that volatilization of either insecticide will not be a major pathway of exposure to aquatic resources.

Reported low vapor pressure values for bifenthrin and β-cyfluthrin suggest that transport from volatilization would be negligible (Table 1).

Transport of Bifenthrin and β-cyfluthrin to Aquatic Resources Via Runoff

The off-site transport of bifenthrin and β-cyfluthrin from runoff to waterbodies is anticipated to be very low for the proposed SLF mist blower and hydraulic spray applications. Previously described program and label restrictions, including buffer zones, and wind direction and weather-related application restrictions, will provide reductions in environmental loading to areas between the area of application and waterbodies. Residues of bifenthrin or β-cyfluthrin that may be washed from treated foliage after application would be minimal. Applications prior to rain events will be avoided to reduce the likelihood of runoff of pyrethroid insecticides from treated plants or soil. Pyrethroid residues that are removed by a rain event would partition to soil organic matter or soil particles, reducing the likelihood of transport to waterbodies. The partitioning to soil and organic matter is supported by laboratory studies where Koc values for both pyrethroid insecticides typically exceed 100,000 suggesting strong adsorption to soil particles in various soil types. Pyrethroid residues bound to soil are less likely to be transported through runoff to waterbodies compared to residues that would occur in the dissolved phase. The use of a 150-ft. or 500-ft. no-application buffer would also reduce the transport of either pyrethroid insecticide to waterbodies from runoff.

Buffer zones have been shown to be effective in removing pesticides from runoff. The effectiveness of buffer zones depends on the chemical fate of a pesticide and site conditions such as soil type, ground slope, and other site attributes. Hatfield et al. (1995) demonstrated that grassed filter strips ranging from 40 to 60 ft. removed 10 to 40% of the herbicides atrazine, cyanazine, and metolachlor, which are all soluble in water. Arora et al. (1996) found that a 66-foot-wide riparian buffer on a 3% slope removed anywhere from 8 to 100% of the herbicides atrazine, metolachlor, and cyanazine during storm events. The variability in pesticide retention within the buffer zone was related to the amount of runoff during storm events. In a review by Neary et al. (1993), buffers of approximately 50 ft., or larger were effective in reducing pesticide runoff to water bodies. Syverson and Bechmann (2004) demonstrated that with an approximate 15-foot-wide buffer, sediment-bound residues of glyphosate, fenpropimorph, and propiconazole were reduced 39, 71, and 63%, respectively. Removal efficiency of soluble fractions of each product was 24 to 70% for glyphosate, 32 to 78% for propiconazole, and 61 to 73% for fenpropimorph. These types of removal efficiencies have been observed for other pesticides as well, such as 2,4-D and trifluralin (Lacas et al., 2005). Asmussen et al. (1977) documented 70% reductions in 2,4-D levels, while Rhode et al. (1980) demonstrated a 94% reduction in the herbicide trifluralin, which has a relative higher binding affinity, using grassed buffers of 24.4 meters (80 ft.). Equivalent buffer distances have been established for trapping sediment, which would suggest that pesticides that sorb to sediment would also be reduced with similar sized buffer zones (Wenger, 1999; Gril et al., 1997). Runoff of bifenthrin and β-cyfluthrin in irrigated field plots have been shown to be negligible after collection and analysis of samples at field edges. Hanzas et al. (2011) reported negligible transport of bifenthrin and β-cyfluthrin at the edge of turf plots that were irrigated at normal levels and were overirrigated after a simulated storm event. Runoff from plots with normal irrigation ranged from 0.003 to 0.006% of the total amount of bifenthrin and 0.010 to 0.011% for β-cyfluthrin after a 1.9 centimeters per hour (cm/h) simulated rainfall event. Transport in runoff from the over irrigation plots ranged from 0.052 to 0.081% for bifenthrin and 0.23 to 0.58% for β-cyfluthrin. The above study did not factor in the use of buffer zones which would further reduce the potential for bifenthrin and β-cyfluthrin runoff into waterbodies.

Currently, there are no environmental fate pesticide simulation models to determine how buffers and other mitigation measures reduce runoff. The environmental fate of bifenthrin and β-cyfluthrin and implementation of the proposed aquatic mitigation measures for the SLF program suggest that negligible residues of either insecticide would occur in waterbodies from runoff.

Transport of Bifenthrin and B-Cyfluthrin to Aquatic Resources Via Drift

The use of a mist blower and hydraulic sprays for bifenthrin and β-cyfluthrin applications suggest that drift will be the primary pathway of exposure to aquatic resources. Measures to reduce drift, such as no-treatment buffer zones, wind direction restrictions, and other measures that will reduce drift from the proposed mist blower and hydraulic spray applications, will be implemented by the SLF program.

Interception of off-site drift by vegetation can also reduce the potential for insecticide transport to waterbodies. Hancock et al. (2019) reported an approximate 96% reduction in instream malathion residues when comparing vegetated and non-vegetated sites. Vegetation between the spray block and the sensitive habitat as well as vegetation at the sensitive site can intercept drift and reduce exposure to aquatic and terrestrial habitats (Dabrowski et al., 2005; Dabrowski et al., 2006; Brown et al., 2004; Longley et al., 1997a, b; Ucar and Hall, 2001). Shallow, isolated. aquatic habitats have been shown to have aquatic and riparian vegetation with canopy coverage ranging from 41 to 81% which may also act to intercept drift (Beechie et al., 2005; Morley et al., 2005). Riaz et al. (2017) evaluated the effects of various aquatic plant species on bifenthrin removal from the water column. Removal efficiencies were 76, 68, and 70% for *Eichornia crassipes*, *Pistia stratiotes*, and algal species (*Chaetomorpha sutoria*, *Sirogonium sticticum*, and *Zygnema* sp.), respectively.

Interception of drift by vegetation from the proposed mist blower and hydraulic spray treatments will be greatest for those waterbodies that are perpendicular to the rail line rights of way. These areas will only receive treatments if vegetation is present that could support SLF populations but treated vegetation would also serve to intercept drift and reduce transport to waterbodies. Waterbodies that occur under rail lines or where there is no substantive vegetation between the treatment area and protected resource would benefit less from interception of drift by vegetation. Riparian areas present along most waterbodies would remove drift as well.

The method of calculating aquatic exposure concentrations and effective buffer zones for the SLF program was done using the drift deposition model AgDrift. AgDrift allows for specific application information to be used as input into the model, and then determine the amount of drift that would occur at a user-defined distance from the spray block. The difference between deposition at the edge of a field and a selected buffer zone can be used to reduce the total amount of insecticide that would be expected at a certain distance from the spray block. Buffer zones can be established, based on the reduction in exposure to levels that would not be expected to result in direct or indirect effects to individuals, populations, or species.

AgDrift is a model that was developed from another drift model, AgDisp, that was developed by the USDA-Forest Service in the early 1980’s (Hewitt et al., 2002; Teske and Curbishley, 2003). The AgDrift model has become a regulatory tool used by the U.S. Environmental Protection Agency (USEPA), Office of Pesticide Programs in estimating pesticide drift. Both models have a tiered approach that allows the user to choose default values or provide more specific data based on the available information. Both models have been validated under various application scenarios in the literature (Duan et al., 1992a; Duan et al., 1992b; Teske et al., 2000; Teske and Thistle, 2004). In general, application predictions slightly underestimate drift within the first 80 m, but overpredict it at increasing distances by a factor of two to four at distances up to approximately 300 m (Bird et al., 2002; Duan et al., 1992a, 1992b; Teske and Thistle, 2003; Thistle et al., 2008).

For this risk assessment, the AgDrift model was used to simulate potential drift from mist blower applications. Input data for the AgDrift model were based on pesticide labels for each product and SLF-specific information about other mitigation measures. Multiple factors can influence pesticide drift; however, release height, wind speed and direction, and nozzle atomization and orientation are the primary factors influencing drift (Bird et al., 1996; Teske et al., 2000). AgDrift does not estimate drift from hydraulic spray applications like those proposed for use in the SLF program. Estimates from mist blower applications were used as a surrogate for the hydraulic spray applications.

The tier one orchard/airblast simulation was selected to estimate the effects of application buffers on drift. The user has limited ability to modify the variables and assess how they impact drift for the orchard/airblast simulation. AgDrift offers two mist blower application options to estimate drift. The mist blower application for grapefruit orchards was selected because it most closely approximates the height of vegetation that may be treated for SLF. The average height of vegetation for treatment under this use scenario in AgDrift is 15 ft. The height of treatment for SLF vegetation is approximately 30 ft.; however, the mist blowers can apply up to 100 ft. Applications are anticipated to occur at 75% of the actual height of the vegetation due to mist droplets moving up into the top of treated vegetation. AgDrift has a default leaf area index of 2.77 that accounts for interception of mist blower droplets due to vegetation. The leaf area index is the ratio of upper leaf surface area to ground area. This value will vary at different SLF treatment areas. The average height of treatment for SLF vegetation is unknown; however, the mist blowers can apply up to 100 ft. AgDrift may underestimate drift values based on the use of higher application heights for SLF. Applications at the maximum capability for mist blowers and hydraulic sprays would occur only in cases where individual trees are at that height and would not occur over an entire swath length. Because applications are occurring along rail line and road rights of way the swath range was selected to cover two tree rows under the mist blower simulation in AgDrift. The default setting is 20 rows; however, the SLF applications will not be applied over an area that large in a continuous spray block. Applications will occur in a linear fashion following railroad tracks and roadway rights of way, except for intermodal areas, airports, seaports, trucking depots, and distribution centers which are considered industrial use sites.

AgDrift assumes that wind direction during application is blowing toward the waterbody to be protected (figure 3). The wind direction under the orchard/airblast tier cannot be modified. Therefore, it does not account for the program measure to avoid applications when the predominant wind direction is toward the habitat to be protected. In addition, applications for SLF would typically occur at wind speeds of 5 mph or less which is less than the default 10 mph wind spend used in AgDrift.

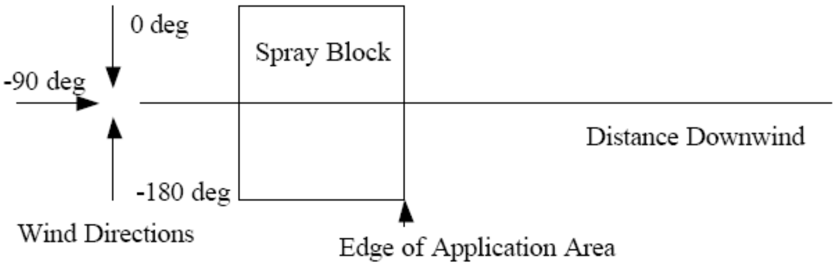

Figure 3. Wind direction relative to the spray block and the distance downwind (Teske and Curbishley, 2003).

AgDrift also does not account for environmental fate of pesticides or the cumulative residues that may result from multiple applications. For this application the maximum use rates for bifenthrin and β-cyfluthrin were used to estimate potential acute residues in waterbodies. The default volume median diameter (VMD) for the drift analysis was 134 micrometers (µm). A larger VMD may be used for the mist blower SLF applications, but AgDrift does not allow changing the input for VMD under the two mist blower treatment options. Hydraulic spray applications typically have a droplet size range of 226 to 400 microns.

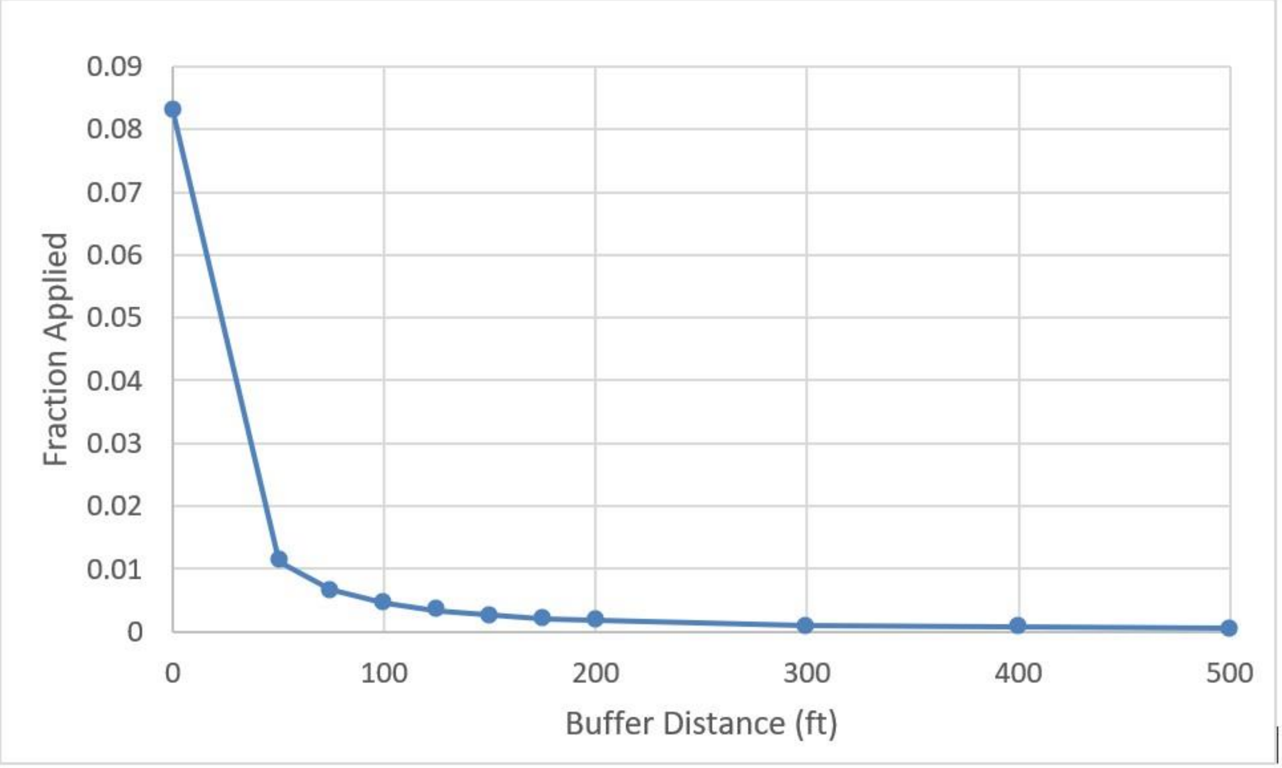

Figure 4. Drift reduction curve for mist blower applications using various buffer distances.

Like other application methods, the amount of off-site drift decreases significantly from the edge of a field over a relatively short distance away from the spray block (figure 4). Drift reductions under this scenario declined 96.8% at 150 ft. and 99.4% at 500 ft. when compared to the edge of field value. AgDrift does not allow the user to estimate a drift value where there is zero drift. Large reductions in drift reduce the exposure and risk to nontarget organisms; however, even with significant reductions at various buffer distances the remaining residues may still pose a risk, especially for highly toxic insecticides such as bifenthrin and β-cyfluthrin. Estimates of aquatic residues are needed to determine if the reductions in drift provide adequate protection to nontarget aquatic organisms.

Aquatic residues were estimated for bifenthrin and β-cyfluthrin in various sized waterbodies using AgDrift for the standard program buffer (150 ft.) and the buffer proposed to protect federally listed aquatic species, including designated critical habitat (500 ft.) (table 2). Waterbody volumes are based on those recommended for screening level impacts to listed species (USEPA, 2020a). The values represent an instantaneous average concentration in static waterbodies of various volumes and do not account for environmental fate or any contribution from runoff. As previously discussed, the contribution from runoff for either insecticide is anticipated to be negligible. Environmental fate and field data for both insecticides suggest that residues that drift to water would rapidly dissipate to the sediment but could accumulate in sediment over time if there are multiple applications and the insecticide is persistent, such as the case for bifenthrin (Table 1).

Table 2. Estimated initial average aquatic residues (ng/L) in various static waterbody dimensions (depth x width (m)) for bifenthrin and β-cyfluthrin using mist blower treatments.

Chemical/Buffer Distance	Initial average aquatic residues (ng/L)[1] in the static waterbody dimension of 0.1 x 2	Initial average aquatic residues (ng/L)[1] in the static waterbody dimension of 1 x 8	Initial average aquatic residues (ng/L)[1] in the various static waterbody dimension of 2 x 100
Bifenthrin (150 ft)	300.84	26.77	4.80
Bifenthrin (500 ft)	24.02	2.30	0.69
β-cyfluthrin (150 ft)	250.24	22.27	3.99
β-cyfluthrin (500 ft)	19.98	1.91	0.57

[1] ng/L = nanograms/Liter

The range of static waterbodies that were used in this exposure analysis are assumed to represent a worst-case scenario for residues when compared to larger bodies of water and flowing bodies of water where dilution would be greater.

The estimated exposure values are for screening purposes and are not considered representative of actual residues that may occur in a field application. While average application heights using mist blowers and hydraulic sprays are expected to be greater, AgDrift does not account for wind direction restrictions that are part of the SLF program. Applications made when the wind direction is blowing away from aquatic habitats would significantly reduce offsite transport of either insecticide from runoff or drift to waterbodies.

Effects Analysis

This section of the risk assessment summarizes available acute and chronic aquatic toxicity data for bifenthrin and β-cyfluthrin. This information will be used to compare effect levels with estimated aquatic residues in the risk characterization section of the risk assessment. Bifenthrin and β-cyfluthrin are considered highly toxic to aquatic invertebrates and vertebrates in acute and chronic exposures. Aquatic invertebrates are more sensitive to both insecticides compared to aquatic vertebrates based on acute and chronic toxicity testing.

Bifenthrin Effects to Aquatic Nontarget Organisms

Acute median lethality concentrations (LC_{50}) for freshwater and marine fish range from 0.15 micrograms active ingredient per liter (µg a.i./L) for the rainbow trout, *Onchorynchus mykiss*, to 19.8 µg a.i./L for the sheepshead minnow, *Cyprinodon variegatus* (USFS, 2015). Bifenthrin chronic toxicity data is limited for freshwater fish. USEPA (2016a) reports a chronic No Observable Effect Concentration (NOEC) of 0.004 µg a.i./L but the value is based on the most sensitive chronic fish toxicity value for a pyrethroid which is tefluthrin. Xiang et al. (2019) exposed zebrafish, *Danio rerio*, for 60 days to low doses (0.02, 0.050 and 0.100 µg a.i./L) of 1S-*cis* and 1R-*cis* bifenthrin enantiomers. The 1S-*cis* enantiomer was shown to have a higher potency compared to the 1R-*cis* enantiomer based on the measurement of several reproductive endpoints. A NOEC was not established for the study due to effects in some endpoints at the lowest test concentration. In another study Forsgren et al. (2013) documented impacts to steelhead trout steroid levels and gonadal development at concentrations of 0.1 and 1.5 µg a.i./L in 14-day sub chronic exposures to bifenthrin. These were the only test concentrations tested in the study, and therefore, a NOEC was not established. USEPA (2016a) reported a chronic NOEC and Lowest Observable Effect Concentration (LOEC) of 0.1 and 0.14 µg a.i./L, respectively, in a 115-day sheepshead minnow life cycle study testing bifenthrin. Effects were based on a significant reduction in fecundity and in the F_0 generation time to hatch.

Several studies assessing the acute and chronic effects of bifenthrin to aquatic invertebrates are available. Bifenthrin is considered highly toxic or very highly toxic to aquatic invertebrates, dependent upon the test species. The most sensitive species in acute bifenthrin exposures is the freshwater amphipod, *Hyallela azteca*, with reported 96-hour median effective concentration (EC_{50}) and LC_{50} values of 0.49 nanograms active ingredient per liter (ng a.i./L) and 1.5 ng a.i./L, respectively (USEPA, 2016a; Graves et al., 2014). Tolerant aquatic invertebrate species include the freshwater cladoceran, *Daphnia magna*, with a reported 48-hour EC_{50} value of 1,100 ng a.i./L. Some species and strains of mosquito, *Culex tritaeniorhynchus*, have also been shown to be tolerant to bifenthrin with 24-hour EC_{50} values at or above 1 mg a.i./L (Yoo et al., 2013).

Bifenthrin acute toxicity data for aquatic vertebrates and invertebrates are characterized below in a species sensitivity distribution (SSD) curve (figure 5) (tables 5a and 5b). The SSD was prepared using the software SSD Toolbox developed by USEPA, Office of Research and Development (USEPA, 2020b). Data points in the SSD represent log transformed 24-hour to 96-hour EC_{50} and LC_{50} values for various freshwater and marine test species. The data also includes acute studies conducted with bifenthrin formulations and the technical active ingredient alone. The SSD was used to estimate a hazardous concentration (HC_5) that represents protection of 95% of the species represented in the SSD. This value can be compared to estimated bifenthrin residues that could occur in waterbodies due to mist blower and hydraulic spray applications. The HC_5 for the acute toxicity SSD for bifenthrin is 9.02 ng/L.

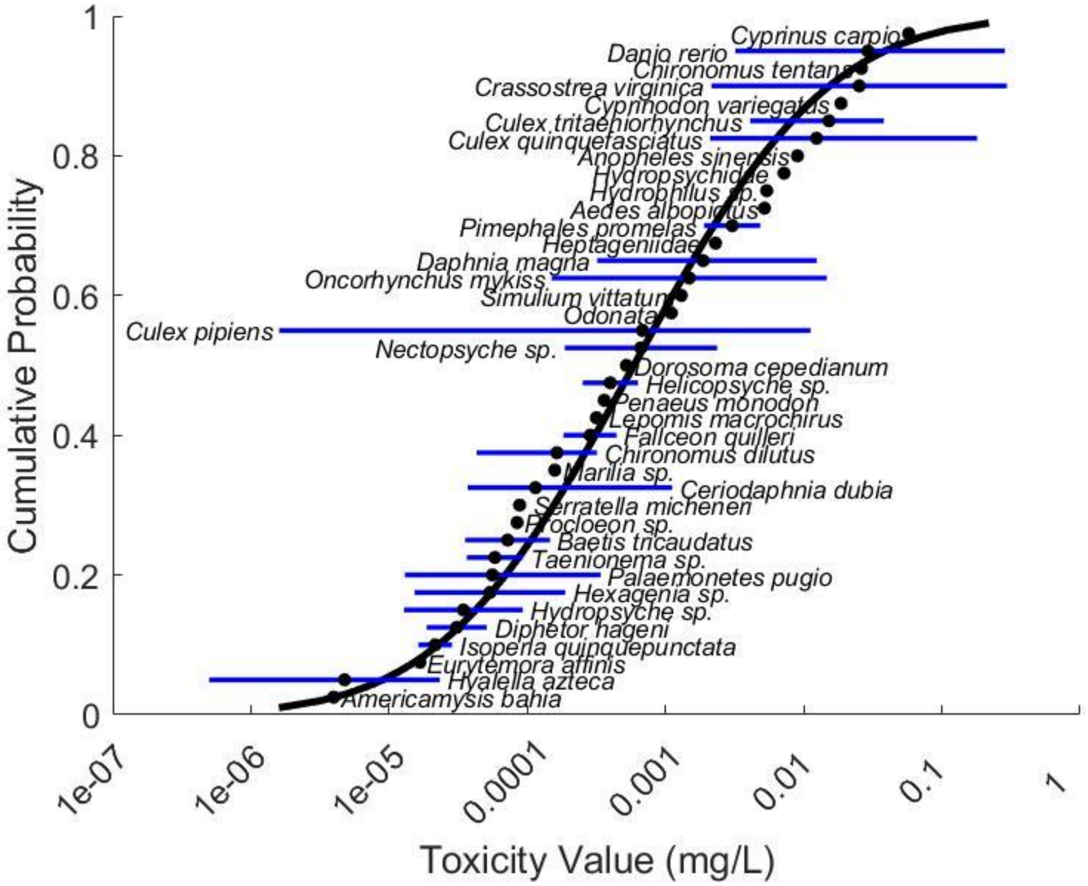

Figure 5. Acute SSD curve using EC50/LC50 bifenthrin aquatic toxicity values.
Note: Black data points with blue lines represent geometric mean values with the associated range when multiple data points are available for the same species.

Chronic toxicity data for bifenthrin is available for several aquatic invertebrate test species. Exposure periods for these studies typically range from 21 to 28 days, except for the amphipod study which was 10 days. Like the acute toxicity data, the amphipod is the most sensitive test species in chronic exposures with a NOEC and LOEC below 0.5 ng/L (table 3).

Table 3. Sublethal toxicity values for aquatic invertebrates in chronic exposures to bifenthrin.

Test Species	NOEC (ng/L)	LOEC (ng/L)	Reference
Hyallela azteca	0.17	0.34	Amweg et al., 2005
Americamysis bahia	1.2	1.3	FAO, 2012
Daphnia magna	1.3	2.9	USEPA, 2016a
D. magna	1	4	Ye et al., 2004
Leptocheirus plumulosus	5	13	USEPA, 2012
D. magna	10	20	Wang et al., 2009

Test Species	NOEC (ng/L)	LOEC (ng/L)	Reference
D. magna	10	20	Zhao et al., 2009
D. magna	20	40	Brausch et al., 2010

The subchronic and chronic EC_{50} and LC_{50} values are represented in the SSD for aquatic vertebrates and invertebrates (figure 6) (tables 5a and 5b). The chronic HC_5 for chronic effects to aquatic vertebrates and invertebrates is 2.9 ng/L.

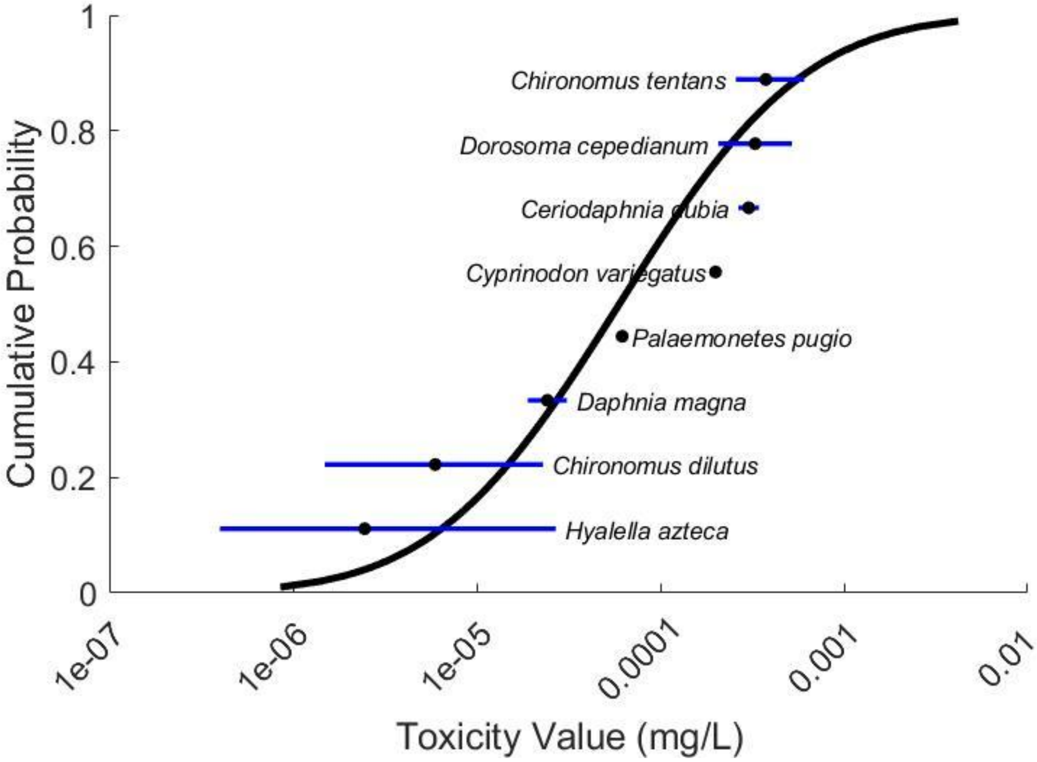

Figure 6. Subchronic and chronic SSD curve using EC50/LC50 bifenthrin aquatic toxicity values. Note: Black data points with blue lines represent geometric mean values with the associated range when multiple data points are available for the same species.

Aquatic invertebrates that occupy the sediment have also been evaluated in toxicity studies due to the environmental fate of bifenthrin and preference to partition to sediment. In a 10-day exposure using the freshwater amphipod *H. azteca*, the NOEC and LOEC values in pore water were 0.05 ng/L and 0.09 ng/L, respectively. The NOEC and LOEC values in sediment were 0.25 µg a.i./kilogram (kg) dry weight (dw) and 0.45 µg a.i./kg-dw, respectively (USEPA, 2016a). In a 28-day study using the marine amphipod, *Leptocheirus plumulosus*, the pore water NOEC and LOEC values were <0.6 ng a.i./L and 0.6 ng a.i./L, respectively. The NOEC and LOEC values in sediment were <5.4 µg a.i./kg-dw and 5.4 µg a.i./kg-dw, respectively (USEPA, 2016a).

Toxicity to algae is low with effects noted at concentrations that exceed the solubility limit for bifenthrin. USEPA (2016a) reports a 7-day EC_{50} greater than 330 µg a.i./L for the vascular plant duckweed, *Lemna minor*. In another 7-day exposure the EC_{50} for the marine diatom *Skeletonema costatum* was greater than 290 µg a.i./L. The NOECs for both studies were the highest test concentration. EFSA (2011) reported an EC_{50} of greater than 8 mg a.i./L for the green algae, *Desmodesmus subspicatus*, testing a Talstar formulation. The same assessment also reported an EC_{50} of 0.822 mg a.i./L for the green algae species *Raphidocelis subcapitata*, based on a reduction in dry weight.

The persistence of bifenthrin, its lipophilic properties (high Kow), and low water solubility suggest it may bioconcentrate in aquatic biota. Bioconcentration factors (BCFs) have been measured in several aquatic organisms. USFS (2015) summarized BCFs (L/kg) from USEPA for bluegill sunfish (6,090 whole fish), *D. magna* (2,500 to 4,600) and *H. azteca* (1,180) in water exposures.

β-cyfluthrin Effects to Aquatic Nontarget Organisms

The reported values below include cyfluthrin and β-cyfluthrin toxicity values. Cyfluthrin is made up of four pairs of enantiomers (eight isomers), while *beta*-cyfluthrin is a mixture of pairs of enantiomers II and IV of cyfluthrin, in a ratio of 1:2. Cyfluthrin values were adjusted where USEPA provides justification; however, in other peer reviewed studies that are presented below the values are represented as reported in each paper.

β-cyfluthrin is highly toxic to fish and very highly toxic to most aquatic invertebrates based on available acute toxicity data. Acute 96-hour LC_{50} values for fish range from 0.068 µg a.i./L in the rainbow trout to 4 µg a.i./L for the sheepshead minnow (USEPA, 2016a). In the acute rainbow trout study the NOEC was reported as less than 0.039 µg a.i./L based on loss of equilibrium, erratic swimming, and lethargy. Chronic fish toxicity data for β-cyfluthrin is limited to an early-life stage (ELS) and full life cycle study using the rainbow trout and fathead minnow, respectively. In the rainbow trout ELS study the NOEC was 0.0042 µg a.i./L based on reduced growth and behavioral effects. The NOEC was based on the estimate of β-cyfluthrin equivalents because the study was conducted using cyfluthrin and the values were adjusted to account for the percent of active isomers in cyfluthrin compared to β-cyfluthrin (USEPA, 2016a). There is also a fish full life cycle study using the fathead minnow with a reported NOEC of 0.14 µg a.i./L (USEPA, 2022).

The range of toxicity values for aquatic invertebrates is variable for β-cyfluthrin with the most sensitive species, the freshwater amphipod, *H. azteca*, having a 96-hour LC_{50} value of 0.34 ng a.i./L, and the least tolerant species, the eastern oyster, *Crassostrea virginica*, having a reported EC_{50} value of 2.5–5.0 µg a.i./L (USEPA, 2022.

β-cyfluthrin acute toxicity data for aquatic vertebrates and invertebrates are characterized below in a SSD curve (figure 7) (table 6). The SSD was used to estimate a HC_5 that represents protection of 95% of the species represented in the SSD. This value can be compared to estimated β-cyfluthrin residues that could occur in waterbodies due to mist blower and hydraulic spray applications. The HC_5 for the acute toxicity SSD for β-cyfluthrin is 2.9 ng/L.

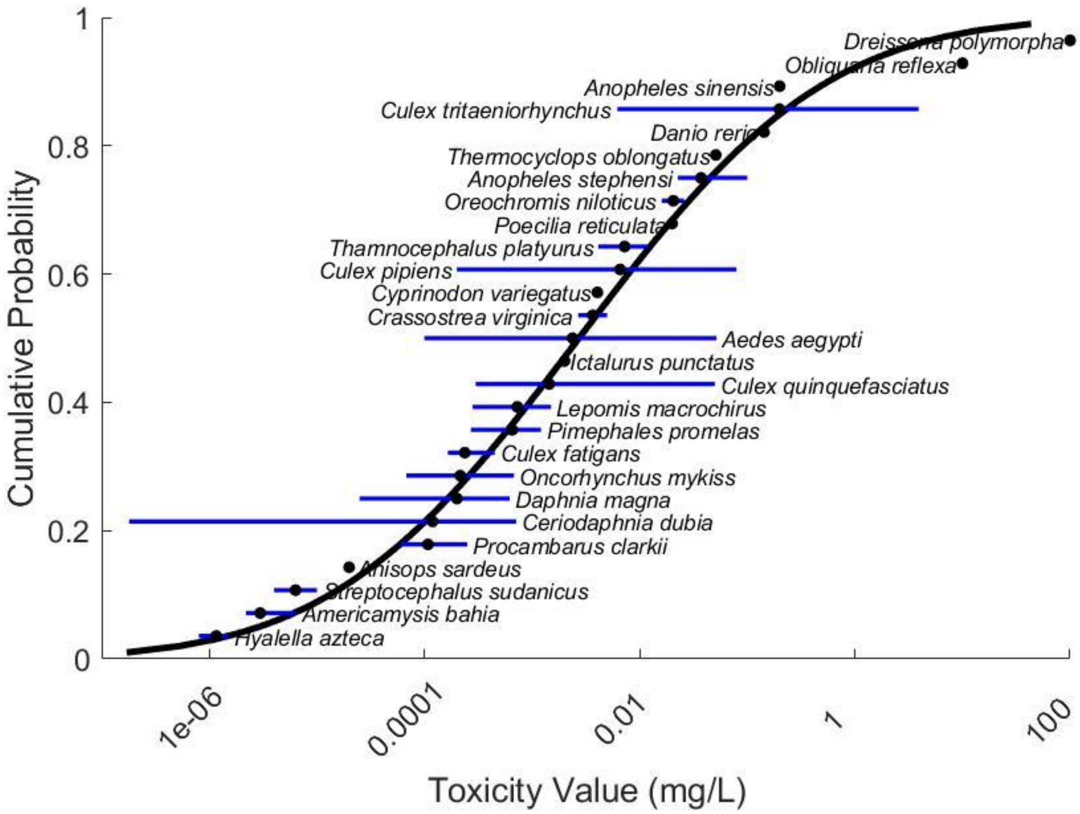

Figure 7. Acute SSD curve using EC50/LC50 β-cyfluthrin aquatic toxicity values. Note: Black data points with blue lines represent geometric mean values with the associated range when multiple data points are available for the same species.

Subchronic and chronic LC_{50} values range from 1.7 ng a.i./L for *H azteca*, to 123 ng a.i./L for *C. tentans* in 10-day exposures (Xu et al., 2007; Deanovic et al., 2013). In a chronic 7-day life cycle study using the freshwater cladoceran, *Ceriodaphnia dubia*, the reported LC_{50} was 712 ng a.i./L. Due to the lack of data points a subchronic and chronic SSD using LC_{50} values was not calculated for β-cyfluthrin.

Amphipods and the mysid shrimp are considered the most sensitive species to chronic exposures of β-cyfluthrin, with the cladoceran, *C. dubia*, the more tolerant species (table 4). Study durations range from 7-days for the life cycle study using *C. dubia*, to 28 days in the life cycle study using the mysid shrimp, *Americamysis bahia*.

Table 4. Sublethal toxicity values for aquatic invertebrates in chronic exposures to β-cyfluthrin.

Test Species	NOEC (ng/L)	LOEC (ng/L)	Reference
Americamysis bahia	0.41	0.83	USEPA, 2016a
Hyalella azteca	2.2	3.7	Deanovic et al., 2013
Daphnia magna	7.4	15.7	USEPA, 2016a
Ceriodaphnia dubia	268	515	Deanovic et al., 2013

Chronic toxicity to aquatic invertebrates has also been evaluated in water/sediment exposures. USEPA (2016a) reports that in the life cycle study using the midge, *C. dilutus*, the NOEC and LOEC in sediment was 1.6 µg a.i./kg and 3.1 µg a.i./kg, respectively. The pore water NOEC and LOEC values were 0.4 ng a.i./L and 7.0 ng a.i./L, respectively. In a 42-day study using the freshwater amphipod, *H. azteca*, the NOEC and LOEC values in sediment were 8 µg a.i./kg and 20 µg a.i./kg, and in pore water the NOEC and LOEC values were 1.4 ng a.i./L and 3.4 ng a.i./L, respectively.

The toxicity of β-cyfluthrin to aquatic plants is low based on available laboratory toxicity testing. USEPA (2016a) reports an EC_{50} value of >181 µg a.i./L for the green algae *R. subcapitata*, and >2 µg a.i./L for another species of green algae, *Scenedesmus subspicatus*, after exposure to cyfluthrin. Both values are greater than the highest test concentration and exceed the solubility limit for β-cyfluthrin. Saenz et al. (2012) reported that the median inhibition concentrations (IC_{50}) exceeded the solubility limit for cyfluthrin for growth and various physiological and biochemical endpoints when testing the effects of a formulated product on various green algal species (*Chlorella vulgaris*, *S. acutus*, *R. subcapitata*). Data do not appear to be available testing the effects of cyfluthrin or β-cyfluthrin on aquatic macrophytes; however, the low toxicity to various algal species, and mode of action for pyrethroid insecticides, suggests that toxicity would be low.

Like most pyrethroid insecticides, cyfluthrin and β-cyfluthrin have high Kow values suggesting that they are lipophilic and could accumulate in aquatic organisms. USEPA (2016a) reports a BCF of 854 for cyfluthrin in whole fish using the rainbow trout. The depuration rate is moderately rapid with a half-life of less than 3 days. The depuration rate is the rate of the loss of cyfluthrin that occurred in rainbow trout after the exposure phase of the study ends.

Risk Characterization

This section of the risk assessment integrates the exposure analysis and potential residues from the proposed mist blower and hydraulic spray applications with the effects analysis to determine the potential for direct or indirect effects to aquatic resources. Direct effects are defined as those effects that may result from exposure to bifenthrin or β-cyfluthrin in aquatic environments. Direct effects can result from acute and chronic exposure. Indirect effects are defined as those effects that may result in reduced prey or impacts to habitat that support other aquatic invertebrates or vertebrates. Exposure values that exceed acute and chronic toxicity values suggest that there may be risk to nontarget organisms and require further discussion regarding assumptions in the risk assessment. Exposure values estimated from drift modeling for mist blower applications were used to represent hydraulic spray applications. This risk assessment provides a screening level approach that makes several conservative assumptions in the exposure and effects analysis sections. These assumptions are discussed in more detail below where residues exceed toxicity values.

Bifenthrin

The implementation of the 500 ft. buffer results in residues that are below the range of acute fish toxicity values in all waterbody volumes suggesting low direct risk in acute exposures (figure 8). The 150 ft. buffer results in residues in the smallest waterbody modeled that exceed acute toxicity values for sensitive fish species.

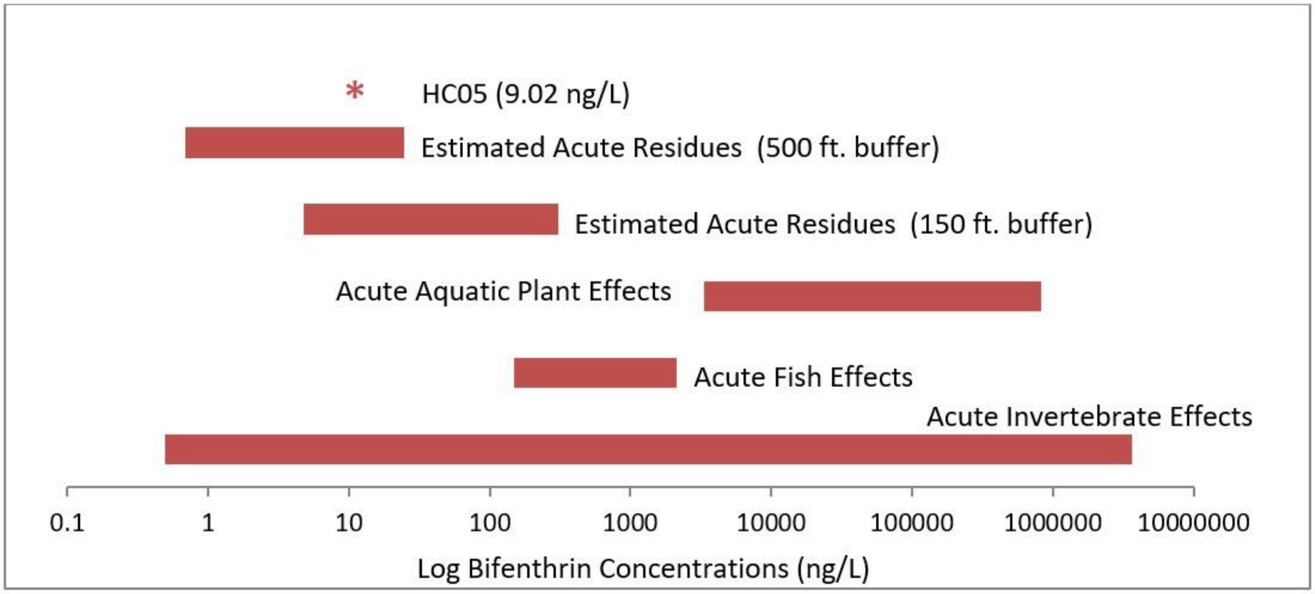

Figure 8. Acute aquatic risk characterization for bifenthrin.

Bifenthrin residues exceed acute invertebrate toxicity values for both buffer sizes in the various waterbodies evaluated in this risk assessment. At 500 ft. residues exceed the lower range of sensitivities for aquatic invertebrates. The residue estimates in this risk characterization do not account for the dissipation of bifenthrin from the water column. Dissipation occurs rapidly for bifenthrin with greater than 90% removal from the water column in less than 24 hours. Many of the acute toxicity values for invertebrates are based on 48-hour or 96-hour exposure durations in either flow through or static renewal studies. These values likely overestimate effects since exposure duration in the environment would be short and at lower concentrations based on laboratory and field-collected environmental fate data for bifenthrin. Sorption is a primary factor affecting bioavailability of bifenthrin, and other pyrethroids. Physicochemical properties of bifenthrin and other pyrethroids, the quality and quantity of (dissolved) organic matter, particle sizes of sediment, the content of suspended solids, aging, and salinity all affect sorption (Lu et al., 2019). In the presence of organic matter and sediments bifenthrin bioavailability to water column aquatic invertebrates and vertebrates would be decreased. Bifenthrin exhibits desorption coefficients comparable to adsorption coefficients that suggest movement to the dissolved phase would be negligible.

Implementation of the 500 ft. buffer results in residues that are below the acute and chronic HC_5 in the static waterbodies modeled in the exposure analysis except for the smallest waterbody (0.1 m x 2 m). Implementation of a 150 ft. buffer results in residues that are below the acute and chronic HC_5 for the largest waterbody but exceeds values in the two larger static waterbody volumes. The HC_5 can be used to evaluate direct impacts to various aquatic taxa as well as indirect effects for those species that rely on aquatic invertebrates and vertebrates as prey items. Indirect effects are anticipated to be low from the use of bifenthrin with implementation of the 500 ft. buffer except for the smallest waterbodies. Direct and indirect risk is greater when implementing the 150 ft. buffer with impacts to the two smallest water body volumes.

No risks are anticipated to aquatic plants from the proposed mist blower and hydraulic spray applications of bifenthrin using either buffer. Indirect effects to habitat for fish and aquatic invertebrates would not be anticipated in any waterbody size based on the lack of residues that would impact aquatic plants. Risk is much lower because the aquatic plant toxicity values are higher than the highest test concentration and exceed solubility for bifenthrin.

The lowest chronic fish endpoint (NOEC = 4 ng a.i./L) is below the acute residues that were estimated using the 500 ft. buffer except for the 0.1 m x 2 m isolated waterbody. Residues exceed the chronic fish NOEC in each of the first two waterbody sizes using the 150 ft. buffer but do not exceed the residues estimated in the largest waterbody evaluated in this risk assessment (2 m x 100 m). These estimates likely overestimate risk because chronic water column exposures to fish are not expected, based on the rapid dissipation of bifenthrin to the sediment. Exposure to bifenthrin in the water column would occur primarily via suspended solids and organic matter.

Chronic risk is greatest for sediment-dwelling aquatic invertebrates. In the case of bifenthrin, residues are expected to persist due to the long half-life under aerobic and anaerobic aquatic conditions (Table 1). The minimum application interval is 28 days and little degradation would be expected between treatments. USEPA (2016b) used the pesticide environmental fate model, Pesticide in Water Calculator (PWC), to estimate water column, pore water, and sediment concentrations for bifenthrin using an orchard airblast application scenario. The PWC estimates pesticide residues in surface water and ground water from drift and runoff using weather data, site specific soils data, and pesticide use and environmental fate information (USEPA, 2016b). Three applications (0.22 lb. a.i./ac) were made every 15 days to pecan orchards in Georgia. Modeled values were the same between water column and pore water concentrations at peak and 21-days post treatment. Based on the results of the PWC modeling the water column residues estimated using AgDrift were assumed to be the same as would occur in pore water. Comparing the range of acute aquatic residues in the three waterbodies modeled in this risk assessment at 150 ft. (4.8 to 300.84 ng/L) and 500 ft. (0.69 to 24.02 ng/L) to the lowest estimated pore water NOEC (0.05 ng/L) suggests the potential for adverse impacts to sediment dwelling invertebrates. These risks are reduced based on the other program measures that are intended to reduce exposure to aquatic nontarget organisms.

β-cyfluthrin

The risk characterization for β-cyfluthrin is similar to bifenthrin when assessing acute risk to fish. The 500 ft. buffer resulted in residues that were below the range of sensitivities to fish species in acute toxicity studies (figure 9). The 150 ft. buffer resulted in residues in the two smaller waterbodies that exceeded the lower range of sensitivities for fish species.

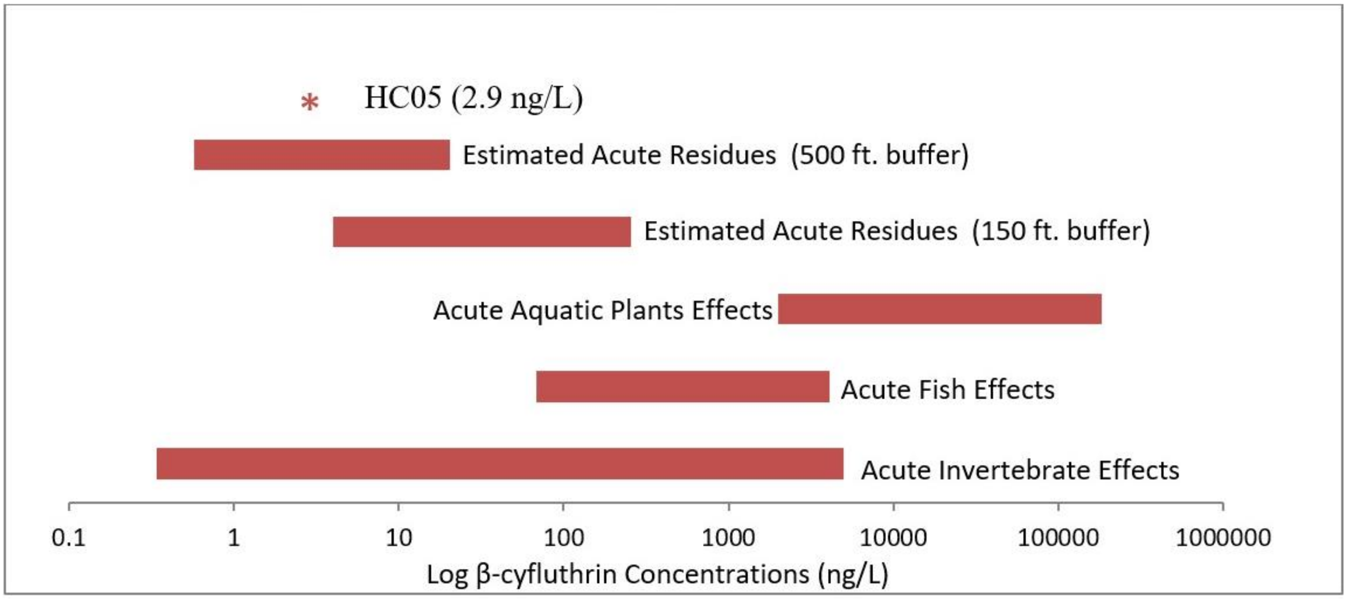

Figure 9. Acute aquatic risk characterization for β-cyfluthrin.

The risk profile for aquatic invertebrates is also similar between bifenthrin and β-cyfluthrin. Some sensitive aquatic invertebrates are at risk from acute and chronic water column exposures. More species are at risk with the implementation of the 150 ft. buffer when compared to the 500 ft. buffer. Like bifenthrin these estimates likely overestimate risk because exposure duration in the environment would be short and at lower concentrations due to the low solubility for β-cyfluthrin, its preference to bind to organic matter and sediments, degradation in the presence of light, and shorter hydrolysis half-life in alkaline waters.

Indirect risks to aquatic species that depend on aquatic vertebrates and invertebrates as prey items are anticipated to be low in all but the smallest waterbody evaluated, based on the HC_{05} value and implementation of the 500 ft. buffer. Exceedance of the HC_{05} occurred in all waterbody volumes evaluated with implementation of the 150 ft. buffer.

β-cyfluthrin risks to aquatic plants from the proposed mist blower and hydraulic spray applications are anticipated to be negligible. Indirect effects to habitat for fish and aquatic invertebrates would not be anticipated in any waterbody size based on the lack of residues that would impact aquatic plants. The actual risk is much lower because the aquatic plant toxicity values are expressed as higher than the highest test concentration and exceed water solubility.

The lowest chronic fish endpoint (NOEC = 4.2 ng a.i./L from the rainbow trout ELS study) is below the acute β-cyfluthrin residues that were estimated using the 500 ft. buffer except for the 0.1 m x 2 m isolated waterbody. Residues exceed the chronic fish NOEC in each of the first two waterbody sizes using the 150 ft. buffer and close to the residues estimated in the larger waterbody volume (3.99 ng/L) These estimates likely overestimate risk because chronic water column exposures to fish are not expected based on the rapid dissipation of β-cyfluthrin to sediment and shorter half-life when compared to bifenthrin. Exposure to β-cyfluthrin in the water column would occur primarily via suspended solids and organic matter.

Chronic risk to aquatic invertebrates from β-cyfluthrin exposure will be greatest for those species that occupy the sediment. The minimum application interval for applications is seven days; however, β-cyfluthrin is expected to degrade between applications based on its sensitivity to light and microbial degradation rates under aerobic and anaerobic conditions (Table 1). Significant bioaccumulation of β-cyfluthrin is not anticipated, reducing chronic risk to sediment-dwelling invertebrates. Chronic risks to benthic invertebrates are reduced, based on the other program measures that are intended to reduce exposure to aquatic nontarget organisms.

Summary

This risk assessment evaluated the acute and chronic risks to aquatic nontarget species from the proposed use of bifenthrin and β-cyfluthrin using mist blower and hydraulic spray applications. The assessment showed acute direct risk to some sensitive fish species using the 150 ft. buffer but not when using the 500 ft. buffer. The assessment showed greater risk to aquatic invertebrates using the 150 ft. buffer compared to the 500 ft. buffer while neither buffer demonstrated risk to aquatic plants. The actual risk estimated in this assessment is anticipated to be much less based on program measures not captured in the exposure analysis. Wind direction is a significant factor in determining off-site drift (Rathnayake et al., 2021). AgDrift does not allow for changing wind direction when simulating drift using mist blower applications. The SLF program is proposing to avoid mist blower and hydraulic spray applications when the wind direction is blowing toward a waterbody. This measure, in addition to the buffer zones that were evaluated in this risk assessment, will significantly reduce drift and runoff that would result in acute and chronic exposure to nontarget aquatic organisms. Other factors such as interception of drift by plants will further reduce the potential for offsite drift. Pesticide interception by plants between the spray block and waterbody will be greatest for those waterbodies perpendicular to the treatment area along railway and roadway rights of way. The intent of the mist blower and hydraulic spray applications is to spray vegetation parallel to the railroad tracks and roadways, as well as vegetation in intermodal areas, airports, seaports, trucking depots, and distribution centers, where insecticide interception by vegetation would be greatest. Within waterbodies the interception of bifenthrin and β-cyfluthrin drift is anticipated to occur more readily in shallow static waterbodies where emergent plants as well as riparian areas would be more prevalent.

USDA-APHIS will conduct environmental monitoring with the proposed SLF program, including spray drift card samples and water and/or sediment samples, where practical to assess whether program measures are effective in reducing off-site bifenthrin and β-cyfluthrin deposition. USDA-APHIS will propose additional mitigation measures if bifenthrin and β-cyfluthrin residues occur adjacent to, or in waterbodies, that could result in potential effects to aquatic nontarget organisms.

The proposed application of bifenthrin and β-cyfluthrin using mist blowers and hydraulic sprays for treating SLF along railroad rights of way, road and highway rights of way, distribution centers, and intermodal areas is anticipated to have low acute and chronic risk to nontarget aquatic organisms based on the implementation of program measures that are intended to reduce drift and runoff to waterbodies.

Tables 5a and 5b provide the acute and chronic aquatic EC50/LC50 values that were used to develop SSDs for bifenthrin.

Table 5a. Acute EC50/LC50 values.

Species	Scientific Name	Acute EC_{50}/LC_{50} (mg/L)	Reference
Eurasian Carp	*Cyprinus carpio*	0.0657	Velisek et al., 2009
Zebrafish	*Danio rerio*	0.0292	Jin et al., 2009
Nonbiting Midge sp.	*Chironomus tentans*	0.0261	Anderson et al., 2006
Eastern Oyster	*Crassostrea virginica*	0.0252	USEPA, 1992
Sheepshead Minnow	*Cyprinodon variegatus*	0.0186	Harper et al., 2008; USEPA, 1992
Southern House Mosquito	*Culex quinquefasciatus*	0.0124	Weerasinghe et al., 2001
Southeast Asia Mosquito	*Anopheles sinensis*	0.0090	Chang et al., 2009
Net-spinning Caddisfly sp.	Hydropsychidae *sp.*	0.0072	Siegfried, 1993
Water Scavenger Beetle sp.	*Hydrophilus sp.*	0.0054	Siegfried, 1993
Asian Tiger Mosquito	*Aedes albopictus*	0.0052	Ali et al., 1995
Fathead Minnow	*Pimephales promelas*	0.0030	Beggel et al., 2010

Species	**Scientific Name**	**Acute EC_{50}/LC_{50} (mg/L)**	**Reference**
Mayfly sp.	Heptageniidae sp.	0.0023	Siegfried, 1993
Common House Mosquito	*Culex pipiens*	0.0020	Shin et al., 2012; Perumalsamy et al., 2010; Hardstone et al., 2007; Lee et al., 1997
Water Flea sp.	*Daphnia magna*	0.0019	Braush et al., 2010; USEPA, 1992, Mokry and Hoagland, 1990
Rainbow Trout	*Oncorhynchus mykiss*	0.0015	Velisek et al., 2009; USEPA, 1992
Striped Black Fly	*Simulium vittatum*	0.0013	Siegfried, 1993
Dragonfly/Damselfly sp.	Odonata sp.	0.0011	Siegfried, 1993
White Miller sp.	*Nectopsyche* sp.	6.6296e-04	Weston et al., 2015
American Gizzard Shad	*Dorosoma cepedianum*	5.2100e-04	Drenner et al., 1991
Caddisfly sp.	*Helicopsyche* sp.	3.9829e-04	Weston et al., 2015
Asian Tiger Shrimp	*Penaeus monodon*	3.6000e-04	Hook et al., 2018
Bluegill	*Lepomis macrochirus*	3.1585e-04	USEPA, 1992
Small Minnow Mayfly sp.	*Fallceon quilleri*	2.8473e-04	Weston et al., 2015
Nonbiting Midge sp.	*Chironomus dilutus*	1.6382e-04	Weston et al., 2015
Caddisfly sp.	*Marilia* sp.	1.5800e-04	Weston et al., 2015
Water Flea sp.	*Ceriodaphnia dubia*	1.1433e-04	Yang et al., 2006; Mokry and Hoagland, 1990
Spiny Crawler Mayfly sp.	*Serratella micheneri*	8.7941e-05	Weston et al., 2015
Small Minnow Mayfly sp.	*Procloeon* sp.	8.4300e-05	Anderson et al., 2006
Small Minnow Mayfly sp.	*Baetis tricaudatus*	7.1993e-05	Weston et al., 2015
Winter Stonefly sp.	*Taenionema* sp.	5.8200e-05	Weston et al., 2015
Daggerblade Grass Shrimp	*Palaemonetes pugio*	5.5804e-05	Pennington et al., 2014; Williamson et al., 2009; Harper et al., 2008
Burrower Mayfly sp.	*Hexagenia* sp.	5.3632e-05	Weston et al., 2015
Net-spinning Caddisfly sp.	*Hydropsyche sp.*	3.4484e-05	Weston et al., 2015
Hagen's Small Minnow Mayfly	*Diphetor hageni*	3.0852e-05	Weston et al., 2015
Little Yellow Stonefly	*Isoperla quinquepunctata*	2.1553e-05	Weston et al., 2015
Calanoid Copepod sp.	*Eurytemora affinis*	1.6700e-05	Weston et al., 2015

Species	Scientific Name	Acute EC_{50}/LC_{50} (mg/L)	Reference
Aztec Amphipod	*Hyalella azteca*	4.7673e-06	Ding et al., 2012; Anderson et al., 2006
Opossum Shrimp sp.	*Americamysis bahia*	3.9700e-06	USEPA, 1992

Geometric mean acute toxicity values were calculated when multiple values for the same species were reported.

Table 5b. Chronic EC50/LC50 values.

Species	Scientific Name	Chronic EC_{50}/LC_{50} (mg/L)	Reference
Nonbiting Midge sp.	*Chironomus tentans*	3.7512e-04	Anderson et al., 2015
American Gizzard Shad	*Dorosoma cepedianum*	3.2840e-04	Denner et al., 1991
Water Flea sp.	*Ceriodaphnia dubia*	3.0294e-04	Deanovic et al., 2013
Sheepshead Minnow	*Cyprinodon variegatus*	2.0000e-04	Pennington et al., 2014
Daggerblade Grass Shrimp	*Palaemonetes pugio*	6.2000e-05	Pennington et al., 2014
Water Flea sp.	*Daphnia magna*	2.4269e-05	Wang et al., 2009
Nonbiting Midge sp.	*Chironomus dilutus*	5.9492e-06	Ding et al., 2012
Aztec Amphipod	*Hyalella azteca*	2.4571e-06	Anderson et al., 2015

Geometric mean chronic toxicity values were calculated when multiple values for the same species were reported.

Table 6. Acute aquatic EC50/LC50 values that were used to develop the SSD for β-cyfluthrin.

Species	Scientific Name	Acute EC_{50}/LC_{50} (mg/L)	Reference
Zebra Mussel	*Dreissena polymorpha*	100.0000	Waller et al., 1993
Threehorn Wartyback	*Obliquaria reflexa*	10.0000	Waller et al., 1993
Southeast Asia Mosquito	*Anopheles sinensis*	0.2000	Chang et al., 2009
Mosquito sp.	*Culex tritaeniorhynchus*	0.1991	Yoo et al., 2013; Shin et al., 2011
Zebrafish	*Danio rerio*	0.1432	Padilla et al., 2012
Cyclopoid Copepod sp.	*Thermocyclops oblongatus*	0.0510	Chippaux et al., 1996
Asian Malaria Mosquito	*Anopheles stephensi*	0.0372	Vasuki and Rajavel 1992, Rajavel et al., 1987
Nile Tilapia	*Oreochromis niloticus*	0.0206	Tejada et al., 1994
Guppy	*Poecilia reticulata*	0.0200	Tejada et al., 1994
Beaver-tail Fairy Shrimp	*Thamnocephalus platyurus*	0.0073	Brausch et al., 2009a
Common House Mosquito	*Culex pipiens*	0.0066	Shin et al., 2012; Perumalsamy et al., 2010
Sheepshead Minnow	*Cyprinodon variegatus*	0.0041	USEPA, 1992

Species	Scientific Name	Acute EC_{50}/LC_{50} (mg/L)	Reference
Eastern Oyster	*Crassostrea virginica*	0.0037	USEPA, 1992
Yellow Fever Mosquito	*Aedes aegypti*	0.0024	Canyon and Hii, 1999 Rodriguez et al., 2007; Vasuki and Rajavel, 1992
Channel Catfish	*Ictalurus punctatus*	0.0020	Waller et al., 1993
Southern House Mosquito	*Culex quinquefasciatus*	0.0014	Weerasinghe et al., 2001; Rajavel et al., 1987
Bluegill	*Lepomis macrochirus*	7.2936e-04	USEPA, 1992
Fathead Minnow	*Pimephales promelas*	6.5592e-04	De Perre et al., 2015; Heath et al., 1994
Rainbow Trout	*Oncorhynchus mykiss*	2.1538e-04	Waller et al., 1993; USEPA, 1992
Water Flea sp.	*Daphnia magna*	2.0059e-04	De Perre et al., 2015; USEPA, 1992; Brausch et al., 2009b
Water Flea sp.	*Ceriodaphnia dubia*	1.1896e-04	Yang et al., 2007
Red Swamp Crayfish	*Procambarus clarkii*	1.0784e-04	Morolli et al., 2006
Backswimmer	*Anisops sardeus*	1.9975e-05	Lahr et al., 2001
Sudanese Fairy Shrimp	*Streptocephalus sudanicus*	6.3246e-06	Lahr et al., 2001
Opossum Shrimp sp.	*Americamysis bahia*	2.9718e-06	USEPA, 1992
Aztec Amphipod	*Hyalella azteca*	1.1598e-06	De Perre et al., 2015; Lanteigne et al., 2015

Geometric mean acute toxicity values were calculated when multiple values for the same species were reported.

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Appendix B. Plants on which SLF has been found.

Plant	Common Name	Family	SLF Life Stage or Activity
Acacia sp. Mill.	Acacia	Fabaceae	Unknown
Acer buergerianum Miq.	Trident maple	Sapindaceae	Unknown
Acer negundo L.	Boxelder	Sapindaceae	Egg, nymph
Acer palmatum Thunb.	Japanese maple	Sapindaceae	Egg, nymph, adult
Acer pictum ssp. *mono* (Maxim.) H. Ohashi	Painted maple	Sapindaceae	Unknown
Acer platanoides L.	Norway maple	Sapindaceae	Egg, nymph, adult
Acer pseudoplatanus L.	Sycamore maple	Sapindaceae	Nymph
Acer rubrum L.	Red maple	Sapindaceae	Egg, nymph, adult
Acer saccharinum L.	Silver maple	Sapindaceae	Egg, nymph, adult
Acer saccharum Marshall	Sugar maple	Sapindaceae	Adult, nymph
Actinidia chinensis Planch	Kiwi	Actinidiaceae	Nymph, adult
Ailanthus altissima (Mill.) Swingle	Tree-of-heaven	Simaroubaceae	Egg, nymph, adult
Albizia julibrissin Durazz.	Persian silk tree	Fabaceae	Nymph
Alcea sp. L.	Hollyhocks	Malvaceae	Nymph
Alnus incana (L.) Moench	Grey alder	Betulaceae	Nymph
Amelanchier canadensis (L.) Medik.	Canadian serviceberry	Rosaceae	Unknown
Amelanchier sp. Medik.	Serviceberry	Rosaceae	Nymph
Angelica daburica (Fisch.ex Hoffm.) Benth. ex. Hook.	Dahurian angelica	Apiaceae	Nymph
Aralia cordata Thunb.	Japanese spikenard	Araliaceae	Nymph
Aralia elata (Miq.) Seem.	Japanese angelica tree	Araliaceae	Nymph
Arctium lappa L.	Greater burdock	Asteraceae	Nymph
Armoracia rusticana G. Gaertn, B. Mey. & Scherb	Horseradish	Brassicaceae	Nymph, adult

Plant	**Common Name**	**Family**	**SLF Life Stage or Activity**
Betula alleghaniensis Britt.	Yellow birch	Betulaceae	Egg
Betula lenta L.	Sweet birch	Betulaceae	Egg, nymph, adult
Betula nigra L.	River birch	Betulaceae	Egg, nymph, adult
Betula papyrifera Marshall	Paper birch	Betulaceae	Egg, nymph, adult
Betula pendula Roth	European white birch	Betulaceae	Nymph
Betula platyphylla Sukaczev	Asian white birch	Betulaceae	Egg, nymph, adult
Broussonetia papyrifera (L.) L'Her. Ex Vent.	Paper mulberry	Moraceae	Unknown
Buxus microphylla Siebold & Zucc.	Japanese boxwood	Buxaceae	Unknown
Buxus sinica (Rehder & E.H. Wilson) M. Cheng	Chinese boxwood	Buxaceae	Egg
Callistephus chinensis (L.) Nees	China aster	Asteraceae	Unknown
Camellia sinensis (L.) Kuntze	Tea	Theaceae	Unknown
Cannabis sativa L.	Hemp	Cannabaceae	Unknown
Carpinus caroliniana Walter	American hornbeam	Betulaceae	Egg
Carya glabra (Mill.) Sweet	Pignut hickory	Juglandaceae	Nymph/adult
Carya ovata (Mill.) K. Koch	Shagbark hickory	Juglandaceae	Egg, nymph, adult
Castanea crenata Seibold & Zucc.	Japanese chestnut	Fagaceae	Egg
Catalpa bungei C.A. Mey.	Manchurian catalpa	Bignoniaceae	Unknown
Cedrela fissilis Vell.	Argentine cedar	Meliaceae	Nymph
Celastrus orbiculatus Thunb.	Oriental bittersweet	Celastraceae	Nymph, adult
Chamerion angustifolium (L.) Holub	Fireweed	Onagraceae	Unknown
Colutea arborescens L.	Bladder senna	Fabaceae	Unknown
Cornus controversa Hensl. Ex Prain	Wedding cake tree	Cornaceae	Nymph, adult
Cornus florida L.	Flowering dogwood	Cornaceae	Egg
Cornus kousa Hance	Kousa dogwood	Cornaceae	Nymph, adult
Cornus officinalis Siebold & Zucc.	Asiatic dogwood	Cornaceae	Nymph, adult

Plant	**Common Name**	**Family**	**SLF Life Stage or Activity**
Cornus sp. L.	Dogwoods	Cornaceae	Nymph, adult
Corylus americana Walter	American hazelnut	Betulaceae	Adult
Diospyros kaki L. f.	Japanese persimmon	Ebenaceae	Egg, nymph, adult
Elaeagnus umbellata Thunb.	Autumn olive	Elaeagnaceae	Nymph, adult
Euphorbia pulcherrima Willd. Ex Klotzsch	Poinsettia	Euphorbiaceae	Adult
Fagus grandifolia Ehrh.	American beech	Fagaceae	Egg, nymph
Ficus carica L.	Edible fig	Moraceae	Unknown
Firmiana simplex (L.) W.E. Wight	Chinese parasoltree	Sterculiaceae	Nymph
Forsythia sp. Vahl	Forsythia	Oleaceae	Nymph
Fraxinus americana iL.	White ash	Oleaceae	Egg, nymph, adult
Glycine max (L.) Merr.	Soybean	Fabaceae	Unknown
Hibiscus sp. L.	Hibiscus	Malvaceae	Nymph
Humulus japonicus Siebold & Zucc.	Hops	Cannabaceae	Nymph
Humulus lupulus L.	Hops	Cannabaceae	Nymph, adult
Juglans cinerea L.	Butternut	Juglandaceae	Nymph, adult
Juglans hindsii (Jeps.) Jeps. Ex R.F. Sm.	Northern California walnut	Juglandaceae	Nymph, adult
Juglans major (Torr.) A. Heller	Arizona walnut	Juglandeaceae	Nymph, adult
Juglans mandshurica Maxim	Manchurian walnut	Juglandaceae	Nymph, adult
Juglans microcarpa Berl.	Texas walnut	Juglandaceae	Nymph, adult
Juglans nigra L.	Black walnut	Juglandaceae	Nymph, adult
Juglans sp. L.	Walnuts	Juglandaceae	Unknown
Juglans x sinensis (D.C.) Rehd.	English walnut	Juglandeaceae	Nymph
Juniperus chinensis L.	Chinese juniper	Cupressaceae	Nymph, adult
Ligustrum lucidum W.T. Alton	Glossy privet	Oleaceae	Unknown
Lindera benzoin L.	Northern spicebush	Lauraceae	Egg

Plant	Common Name	Family	SLF Life Stage or Activity
Liriodendron tulipifera L.	Tuliptree	Magnoliaceae	Egg, nymph, adult
Lonicera sp. L.	Honeysuckle	Caprifoliaceae	Nymph
Luffa sp. Mill.	Sponge gourd	Cucurbitaceae	Nymph
Maackia amurensis Rupr. & Maxim.	Amur Maackia	Fabaceae	Nymph
Magnolia kobus D.C.	Kobus magnolia	Magnoliaceae	Nymph
Magnolia obovata Thunb.	Japanese bigleaf magnolia	Magnoliaceae	Nymph
Mallotus japonicus Muell. Arg.	East Asian mallotus	Euphorbiaceae	Adult
Malus pumila Mill.	Paradise apple	Rosaceae	Egg, nymph, adult
Malus spectabilis (Aiton) Borkh.	Asiatic apple	Rosaceae	Unknown
Malus sp. Mill	Apple	Rosaceae	Adult
Melia azedarach L.	Chinaberry tree	Meliaceae	Nymph, adult
Metaplexis japonica (Thunb.) Makino	Rough potato	Apocynaceae	Nymph
Monarda sp. L.	Bee balm	Lamiaceae	Nymph
Morus alba L.	White mulberry	Moraceae	Nymph
Morus bombycis Koidz.	Korean mulberry	Moraceae	Nymph
Nicotiana sp. L.	Tobacco	Solanaceae	Unknown
Nyssa sylvatica Marshall	Blackgum	Cornaceae	Nymph, adult
Ocimum basilicum L.	Basil	Lamiaceae	Nymph
Osmanthus sp. Lour.	Devilwoods	Oleaceae	Unknown
Ostrya virginiana K. Koch	American hophornbeam	Betulaceae	Egg
Parthenocissus quinquefolia (L.) Planch.	Virginia Creeper	Vitaceae	Nymph, adult
Paulownia kawakamii Ito	Sapphire dragon tree	Paulowniaceae	Unknown
Paulownia tomentosa (Thunb.) Siebold & Zucc. Ex Steud.	Princesstree	Paulowniaceae	Unknown
Phellodendron amurense Rupr.	Amur corktree	Rutaceae	Egg, nymph, adult
Philadelphus schrenkii Rupr.	Mock orange	Hydrangeaceae	Nymph

Plant	**Common Name**	**Family**	**SLF Life Stage or Activity**
Phyllostachys heterocycla (Carriere) Matsum.	Tortoiseshell bamboo	Poaceae	Unknown
Picrasma quassioides (D. Don.) Benn.	Nigaki	Simaroubaceae	Nymph, adult
Pinus strobus L.	Eastern white pine	Pinaceae	Egg
Platanus orientalis L.	Oriental plane tree	Platanaceae	Nymph, adult
Platanus occidentalis L.	American sycamore	Platanaceae	Egg, adult
Platanus x *acerifolia* (Aiton) Willd.	London plane tree	Platanaceae	Egg
Platycarya strobilacea Siebold Zucc.	Platycarya	Juglandaceae	Unknown
Platycladus orientalis (L.) Franco	Oriental arborvitae	Cupressaceae	Nymph, adult
Populus alba L.	White Poplar	Saliaceae	Egg
Populus grandidentata Michx.	Bigtooth aspen	Salicaceae	Nymph/adult
Populus koreana J. Rehnder	Korean poplar	Salicaceae	Adult
Populus simonii Carriere	Simon's poplar	Salicaceae	Unknown
Populus tomentiglandulosa T. Lee	Korea poplar	Salicaceae	Adult
Populus tomentosa Carriere	Chinese white poplar	Salicaceae	Unknown
Prunus armeniaca L.	Apricot	Rosaceae	Egg, nymph, adult
Prunus avium (L.) L.	Sweet cherry	Rosaceae	Egg
Prunus cerasus L.	Sour cherry	Rosaceae	Unknown
Prunus mume Siebold & Zucc.	Japanese apricot	Rosaceae	Nymph, adult
Prunus persica (L.)	Peach/nectarine	Rosaceae	Nymph, adult
Prunus salicina Lindl.	Japanese plum	Rosaceae	Nymph, adult
Prunus serotina Lindl.	Black cherry	Rosaceae	Egg, nymph, adult
Prunus serrulata Lindl.	Japanese flowering cherry	Rosaceae	Egg
Prunus x yedoensis Matsum.	Hybrid cherry	Rosaceae	Egg
Pseudocydonia stenoptera C. DC.	Chinese wingnut	Juglandaceae	Nymph
Punica granatum L.	Pomegranate	Lythraceae	Egg, nymph, adult

Plant	**Common Name**	**Family**	**SLF Life Stage or Activity**
Pyrus sp. L.	Pear	Rosaceae	Nymph
Quercus acutissima Carruthers	Sawtooth oak	Fagaceae	Egg, nymph, adult
Quercus aliena Blume	Oriental white oak	Fagaceae	Nymph
Quercus montana Willd.	Chestnut oak	Fagaceae	Egg, nymph
Quercus rubra L.	Northern red oak	Fagaceae	Egg, nymph
Quercus sp. L.	Oak	Fagaceae	Unknown
Rhus chinensis Mill.	Chinese sumac	Anacardiaceae	Nymph
Rhus typhina L.	Staghorn sumac	Anacardiaceae	Adult, nymph
Robinia pseudoacacia L.	Black Locust	Fabaceae	Egg, nymph, adult
Rosa hybrida L.	Hybrid rose	Rosaceae	Nymph
Rosa multiflora Thunb.	Multiflora rose	Rosaceae	Nymph
Rosa rugosa Thunb.	Rugosa rose	Rosaceae	Nymph
Rosa sp. L.	Rose	Rosaceae	Nymph
Rubus crataegifolius Bunge	Korean raspberry	Rosaceae	Nymph
Rubus sp. L.	Blackberry and raspberry	Rosaceae	Nymph
Salix babylonica L.	Weeping willow	Salicaceae	Nymph, adult
Salix koreensis Andersson	Korean willow	Salicaceae	Nymph, adult
Salix matsudana Koidz.	Corkscrew willow	Salicaceae	Nymph, adult
Salix sp. L.	Willow	Salicaceae	Egg, nymph, adult
Salix udensis Trautv. & C.A. Mey	Willow	Salicaceae	Nymph, adult
Salvia sp. L. (annual excluded)	Perennial salvia	Lamiaceae	Nymph
Sassafras albidum (Nutt.) Nees	Sassafras	Lauraceae	Egg, nymph, adult
Sorbaria sorbifolia (L.) A. Braun	False spiraea	Rosaceae	Nymph
Sorbus commixta Hedl.	Japanese rowan	Rosaceae	Nymph
Styphnolobium japonicum (L.) Schott	Japanese pagoda tree	Fabaceae	Egg
Stynax japonicus Siebold & Zucc.	Japanese snowbell	Styracaceae	Egg, nymph, adult

Plant	**Common Name**	**Family**	**SLF Life Stage or Activity**
Styrax obassia Siebold & Zucc.	Fragrant snowbell	Styracaceae	Nymph, adult
Syringa vulgaris L.	Common lilac	Oleaceae	Egg
Tamarix chinensis Lour.	Five-stamen tamarix	Tamaricaceae	Unknown
Tetradium daniellii (Benn.)	Bee-bee tree	Rutaceae	Egg, nymph, adult
Tetradium spp. Lour.	Tetradium	Rutaceae	Adult
Thuja occidentalis L.	Arborvitae	Cupressaceae	Nymph
Tilia americana L.	American basswood	Meliaceae	Egg, nymph, adult
Toona sinensis (A. Juss.) M. Roem.	Chinese mahogany	Meliaceae	Egg, nymph, adult
Toxicodendron radicans (L.) Kuntze	Poison ivy	Anacardiaceae	Nymph
Toxicodendron vernicifluum (Stokes) F.A. Barkley	Chinese lacquer	Anacardiaceae	Nymph
Ulmus pumila L.	Siberian elm	Ulmaceae	Unknown
Ulmus rubra Muhl.	Slippery elm	Ulmaceae	Nymph, adult
Ulmus sp. L.	Elms	Ulmaceae	Egg
Vaccinium angustifolium Aiton	Lowbush blueberry	Eriacaceae	Nymph
Viburnum prunifolium L.	Blackhaw	Adoxaceae	Egg
Vitis amurensis Rupr.	Amur grape	Vitaceae	Nymph, adult
Vitis labrusca L.	Fox grape	Vitaceae	Egg
Vitis riparia Michx.	Riverbank grape	Vitaceae	Adult
Vitis sp. L.	Wild grape	Vitaceae	Nymph, adult
Vitis vinifera L.	Wine Grape	Vitaceae	Egg, nymph, adult
Zanthoxylum simulans	Chinese pepper	Rutaceae	Egg, nymph, adult
Zelkova serrata (Thunb.) Makino	Japanese zelkova	Ulmaceae	Egg

Source: (Barringer and Ciafré 2020)