Use and Safety Characterization of Pesticides Used on Agricultural Properties Nearby the Proposed Site for the Portland Water Bureau's Bull Run Filtration Facility

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Executive Summary

Agricultural and forestry land uses near the proposed Portland Water Bureau's Bull Run Filtration Facility (designated hereafter as the "Filtration Facility") involve periodic applications of pesticides (i.e., insecticides, herbicides, and/or fungicides) during routine production practices in compliance with pesticide labels (referred to herein as "pest management practices"). County approval for permitting the Filtration Facility requires the Water Bureau to prove its land use would not cause a significant impact on accepted agricultural/forestry practices such as pesticide use in a manner that is out of compliance with ORS 215.296 as incorporated into County code. Furthermore, the Water Bureau desires to ensure that surrounding agriculture/forest uses of pesticides will not be detrimental to the Filtration Facility.

To determine whether potential conflicts might arise between accepted agricultural/forest practices in the "surrounding lands" and the Filtration Facility, a risk-based analysis was conducted of the most likely causes of any conflict. For this analysis, "conflict" was defined as (1) exposures of "bystanders" (defined as Filtration Facility workers and visitors) to pesticides inconsistent with EPA-defined safe levels or (2) deposition of drifting residues onto open water basins that would cause the finished water from the Filtration Facility to exceed established safe drinking water regulatory standards or guidelines. Because pesticide spray drift is an inevitable phenomenon owing to the physics of droplet formation through spray nozzles and the physics of atmospheric transport, conflict would be nil if (1) potential exposures could be shown to meet EPA's definition of a safe level of exposure (a.k.a., Level of Concern, LOC) and (2) any residual pesticides in finished water could be shown to be below regulatory water quality standards and guidelines protective of human health. If conflict is nil, then the Filtration Facility does not present a risk of forcing a significant change in, or significantly increasing the cost of, accepted farm or forest practices in the surrounding lands.

EPA's LOCs are carefully determined by EPA in order to provide a "reasonable certainty of no harm" as defined in regulatory law. Whether EPA's LOC standards for safety regarding potential exposure of bystanders are met can be expressed as the "equivalent safe distance" (ESD) that estimates the minimum distance from a spray swath a bystander could be without harm if they were directly exposed to spray drift.

For consideration of possible spray drift to open water basins, a reference concentration (RC) in a unit volume of water at the minimum distance separating surrounding lands and the basins was generated. The RC was then used to estimate any residual levels of pesticide that could hypothetically be present in finished water from the Filtration Facility, taking into consideration water volume and filtration operations. That analysis has been performed by Mark Graham, P.E. in a companion memorandum to this report (referred to herein as the Graham Report). The Graham Report compares the resulting potential residual levels of pesticides to regulatory water quality standards and guidelines protective of human health. Any resulting level below the standards and guidelines would satisfy regulatory definitions of water safe for human consumption and therefore show that there is no drinking water related conflict between the Filtration Facility and agricultural and forestry uses in the surrounding lands.

A survey of pesticide users was conducted to define the pesticides used in accepted farm and forest practices in the surrounding lands of the Filtration Facility. Pesticide product formulation labels have the force of federal law and define the legally permitted uses, restrictions, and accepted practices. Therefore, pesticide product labels were reviewed for accepted farm and forest practices.

To determine ESDs, pesticides used in the surrounding lands were examined for toxicological information that EPA uses when making decisions to register formulations of the active

ingredients. LOCs (expressed as mg of pesticide per kilogram of body weight, mg/kg, and synonymous with EPA's reference dose (RfD) or population adjusted dose (PAD)), were investigated in EPA registration decision documents publicly available through the website regulations.gov. The allowable uses, including maximum use rates per acre, were gathered from the pesticide product label database CMDS (Crop Data Management Systems, Inc.) and cross checked with EPA's database of pesticide product labels.

A hazard ranking procedure was developed that integrated application rates on a per acre basis with EPA's defined PAD for acute or short-term exposure to bystanders and pesticide users. The hazard ranking defined which pesticides would likely be of most concern in the event of inadvertent exposures to people or to water during spraying operations. The hazard rankings cover a wide diversity of pesticide types with different application rates and potential hazards, and therefore the analysis is useful for predicting whether future uses of alternative or newly registered pesticides will present any limitations to agricultural or forest operations owing to the Filtration Facility.

For characterizing safety to bystanders during spraying operations, pesticide drift at distances up to 1000 feet from a sprayed field were simulated with the software AgDrift. EPA uses this publicly available software program for its own risk assessments related to use of pesticides. AgDrift outputs spray drift-deposition data in terms of percentage of field application rates (FAR) falling to ground over a distance up to 1000 feet from the sprayed perimeter. The percentages of FAR were transformed into body dose units. Thus, a body dose was associated with each downwind distance output by the model. EPA's designated PADs for each pesticide active ingredient were overlaid horizontally on the drift-deposition curves. Where the PAD line overlapped the deposition curve, a vertical line was dropped to estimate the ESD. ESDs for all the pesticides were tabulated from output in an Excel spreadsheet analysis.

In addition to determining ESDs for characterizing potential impacts on bystanders, potential deposition of pesticide residues onto uncovered water basins at a downwind distance of 100 feet was modeled. From the model output, concentrations of pesticides in a ten foot deep body of water were estimated. The pesticide concentration estimated to potentially occur in water at a downwind distance of 100 feet was designated as the RC. The RC distance was chosen to represent a conservative minimum distance between a farm's spraying operation and a water basin. As noted above, the Graham Report uses the RC to estimate any residual levels of pesticide that could hypothetically be present in finished water from the Filtration Facility, taking into consideration water volume and filtration operations, and then compares the resulting potential residual levels of pesticides to regulatory water quality standards and guidelines protective of human health.

All ESDs determined for pesticide uses consistent with product label mandates would meet EPA's defined safety standards within 85 feet or less of a spray swath. The modeled RC for all pesticides were significantly less than the concentrations of concern delineated in the Graham Report, even before taking into account the significant dilution potential when simulations further considered the dynamic water level fluctuations of the open basins. Taking into account the dilution and dynamic water movement of the filtration facility operations, the maximum concentration in the finished water will be less than two percent of the concentration of concern (as defined in the Graham Report) -- well below regulatory water quality standards and guidelines protective of human health. The potential introduction of chemicals will be further mitigated by the construction of berms and plantings between the property line and open water basins, as well as the elevation of open water basins above the level of agricultural fields. These features will disperse or capture pesticide drifting from adjacent properties.

The overall conclusion of this risk characterization is twofold. First, the proposed Filtration Facility will not force a significant change in, nor significantly increase the cost of, accepted farm or forest practices in the surrounding lands of the Filtration Facility site because the risk of conflict is nil. Second, the location of the Filtration Facility at a site near pesticide users will not create a risk of pesticide residue concentrations in the finished water that exceed safe drinking water quality standards or guidelines. These conclusions are supported by the following observations. For all pesticides used in the surrounding lands of the Filtration Facility, modeled scenarios of pesticide drift and exposure using EPA's publicly available model AgDrift showed that any drift beyond a spray swath would not exceed safe levels defined for human health and drinking water quality. Because of nil risk of conflicts at the Filtration Facility, accepted farm and forest practices in the surrounding lands of the Filtration Facility can continue without any significant change or increased cost and finished water will not contain pesticide residues that exceed safe drinking water quality standards or guidelines or otherwise pose a human health risk.

Glossary

Acute toxicity	Adverse response of an organism to single and/or short term exposures to chemicals that may or may not cause lethality
AgDrift	A publicly accessible software that can simulate drift to distances of 1000 feet from an application of a pesticide and used to estimate the likelihood that any bystander or body of water would exceed EPA LOCs
Aggregate Risk	All exposure routes, including dietary, drinking water, and residential use scenarios
aPAD	Acute population adjusted dose; EPA defined level of concern for exposures to assure a reasonable certainty of no harm from singular or short-term exposures. The PAD takes into account any special sensitivity of children, child bearing and nursing mothers, and potential endocrine system effects. Often the aRfD (acute reference dose) and aPAD are identical.
Application rates	Typically expressed as pounds of active ingredient per acre and were transformed to mg/m^2 units for conducting risk analysis
aRfD	Acute Reference Dose; an exposure below EPA's level of concern from single or short-term exposure derived from toxicological studies defining a NOAEL (no observable adverse effect levels) to which a safety factor (called a MOE, margin of exposure) is applied
Bystanders	Filtration Facility workers and/or visitors
Bystander areas	Areas inside the Filtration Facility perimeter fence where bystanders may be located. Any landscaping or other work done outside the perimeter fence will be rescheduled if pesticide use is observed.
CDMS	Crop Data Management Systems, Inc.
Chronic toxicity	Non-lethal adverse effects from daily exposures to chemicals occurring over extended periods of time including a lifetime
County	Multnomah County, Oregon
cPAD	Similar to the aPAD but exposures are considered over a lifetime (at least 70 years)
cRfD	Chronic Reference Dose; the dose from which the PAD is calculated in reference to a lifetime of exposure (at least 70 years)
DAF	Dermal adjustment factor
De minimis	Insignificant enough to be disregarded
Dermal toxicity	Adverse effect resulting from exposures to bare skin
Ecological Receptors	Humans or other non-targeted organisms
EDSP	EPA's Endocrine Disruptors Screening Program
EPA	US Environmental Protection Agency
EPA OPP	EPA Office of Pesticide Programs: the agency's Division designated with the authority to conduct all risk assessments for chemicals designated as pesticides under FIFRA.

ESD	Equivalent Safe Distance, the distance between the edge of a pesticide spray operation and a bystander such that an exposure would not exceed EPA's established LOCs and thus comply with the EPA safety standard of "reasonable certainty of no harm."
Filtration Facility	The Water Bureau's Bull Run Filtration Facility, proposed to be located at a site on Carpenter Lane in east Multnomah County
FAR	Field application rate
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FQPA	Food Quality Protection Act
GLP	Good Laboratory Practices regulations as defined in FIFRA
HR	Hazard Ranking
In vitro	Laboratory test not involving live animals but rather tissue cultures
Legal standard of safety	EPA's reasonable certainty of no harm standard
LOC	EPA's Levels of Concern established to ensure compliance with the legal standard of safety, expressed as mg of pesticide per kilogram of body weight, mg/kg, and synonymous with EPA's reference dose (RfD) or population adjusted dose (PAD) from both acute and chronic exposures.
MOA	Mode of Action; the initial biochemical interaction of a chemical with molecular receptors, defined as proteins that trigger (or initiate) complex metabolic pathways and physiological processes, or proteins that function as enzymes
MOE	Margin of exposure; equivalent to a safety factor applied to the NOAEL; the MOE usually ranges from 100 to 1000
NOAEL	No observable adverse effect level based on an array of EPA required toxicological studies, forming the basis for estimating an RfD or PAD.
NRC	National Research Council: the research arm of the U.S. National Academy of Sciences
OPP	EPA Office of Pesticide Programs
Oregon Revised Statute (ORS) 215.296	Standards for approval of certain uses in exclusive farm use zones, referenced in this report as implemented in Multnomah County, Oregon code
PAD	Population Adjusted Dose, the level of exposure from any source above which EPA concludes that a risk from pesticide exposure to any age group is of no concern.
PBPK	Physiologically Based Pharmacokinetic model based on human physiology that is used to estimate whole body exposures
Pesticides	Insecticides, herbicides, and/or fungicides as defined under FIFRA
POD	Point of Departure: statistical estimate of a NOAEL; sometimes used to describe an observed NOAEL
PWB	Portland Water Bureau
QA	Quality assurance

RC	Reference concentration; the estimated concentration in water occurring 100 ft from a spraying operation
RfD	Reference Dose
Spray swath	The shape and width pattern of pesticide spray droplets emitted from a nozzle under pressure during application; often equivalent to spraying one crop row
Surrounding lands	The area of land surrounding the Filtration Facility site analyzed by the two farm and forest experts evaluating the Filtration Facility, Globalwise Inc. and Mason, Bruce & Girard, Inc, with the area defined based on criteria provided in those expert reports.
Systemic toxicity	Adverse effects resulting from chemicals that have entered an organism's circulatory system and distributed throughout the body
Tolerance	The maximum pesticide residue allowed on any food commodity authorized under the Federal Food Drug and Cosmetic Act (FFDCA)
Toxicological endpoint	A measured adverse effect at any level of biological organization ranging from molecular to behavioral
Water Bureau	The Portland Water Bureau
UF	Uncertainty factors
USDA	U.S. Department of Agriculture
VMD	Volume Median Diameter

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1. Project Goal Overview

1.1 Problem Characterization

Oregon Revised Statute ORS 215.296 (*Standards for approval of certain uses in exclusive farm use zones*) dictates that conditional use permits in designated farm use zones may be approved only if a local government finds that the use will not "force a significant change in accepted farm or forest practices on surrounding lands devoted to farm or forest use." The local government must also find that land use changes will not "significantly increase the cost of accepted farm or forest practices on surrounding lands." Multnomah County has incorporated the ORS 215.296 standard into the requirement for certain conditional uses in the MUA-20 zone, where the proposed Filtration Facility will be located. References in this report to the ORS 215.296 standard are intended to also reference that standard as incorporated into Multnomah County code for the MUA-20 zone.

Agricultural and forestry land uses adjacent to the proposed Portland Water Bureau's (the "Water Bureau") Bull Run Filtration Facility ("Filtration Facility") require periodic applications of pesticides (i.e., insecticides, herbicides, and/or fungicides) during routine production practices. County approval for permitting the Filtration Facility requires the Water Bureau to show that its land use would not cause a significant impact on nearby accepted agricultural/forestry practices, including pesticide use, in a manner that is out of compliance with ORS 215.296. Furthermore, the Water Bureau must show that the proposed Filtration Facility is not sensitive to the use of pesticides by nearby agriculture/forest uses in a manner which would force a significant change in or significantly increase the cost of accepted farm or forest practices on those surrounding lands.

To obtain a conditional use permit for the Filtration Facility, the Water Bureau must provide evidence of compliance with the provisions of ORS 215.296, as incorporated into Multnomah County code. To ensure there is no effect of the proposed land use either on surrounding farm/forestry practices or on the filtration facility itself, two scenarios involving pesticide use are addressed by this report. First, any applications of pesticides may result in chemical residues drifting beyond the borders of a sprayed field. Because of the proximity of operating farm uses to the proposed Filtration Facility, pesticide residues may drift from the sprayed areas to adjacent lands where Filtration Facility workers and/or visitors ("bystanders") could theoretically be exposed. Second, drifting sprays may deposit on water basins at the Filtration Facility, with the concern that these deposits could theoretically be at sufficient levels to create concerns about the safety of drinking water.

Some pesticide spray drift is inevitable owing to the physics of spray particle (droplets) formation and atmospheric transport. However, as demonstrated by this report, when accepted practices for sprayer operation and product label mandates are followed, drifting chemical residues would be sufficiently de minimis such that any exposure to persons at or around the Filtration Facility would not exceed the US Environmental Protection Agency's (EPA) safety standards. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA is charged with registering all pesticide products only after ensuring exposures would comply with the legal standard of safety known as a "reasonable certainty of no harm." EPA conducts risk assessments for potential human health and ecological effects that ensure exposures under any pesticide use scenario would not exceed the agency's "Levels of Concern" (LOC) that are established for compliance with the legal standard of safety.

Pesticide exposures to bystanders above EPA's LOC could result in conflicts with current farm or forest practices, thus potentially creating problems with ORS 215.296 compliance if

operations complying with Federal and State laws regarding pesticide use had to significantly change their accepted practices.

To ensure compliance with ORS 215.296 as implemented by County code, the Water Bureau seeks to ensure that the distance between the outer boundaries of the proposed Filtration Facility, including the water basins, and the surrounding farm and forest land is sufficiently wide so that potential human exposures meet EPA's safety benchmarks and there will be no impact on accepted farm and forest practices in the surrounding lands. Similarly, the Water Bureau seeks to ensure that any potential drifting of pesticides to open water basins would not result in finished water that exceeds human health criteria for drinking water.

1.2 Strategy for Ensuring Water Bureau Compliance with ORS 215.296 and Lack of Detriment to the Filtration Facility from Surrounding Accepted Farm and Forest Practices

As part of the pesticide risk assessment and registration decision process, EPA determines if pesticide drift during application and thereafter might expose bystanders to residues exceeding EPA's LOCs for human health or might cause water contamination exceeding drinking water health criteria and/or enforceable standards under the Safe Drinking Water Act. To estimate likely exposures to pesticides from agricultural sprays, EPA simulates drift using computer modeling. The agency sanctioned model is named "AgDrift", a publicly accessible software that can simulate drift to distances of 1000 feet from an application of a pesticide. AgDrift can be used to estimate the likelihood that any bystander or body of water would exceed EPA's LOCs. The model output can be expressed as the "equivalent safe distance" (ESD). Within this report, the ESD is defined as the distance between the edge of a pesticide spray operation and a bystander such that an exposure would not exceed EPA's established LOCs and thus comply with the EPA safety standard of "reasonable certainty of no harm."

For drift to a water body, the modeled output can be expressed as a unit concentration of pesticide. At a conservative minimum distance of 100 ft estimated between a likely spraying operation and open basins within the Filtration Facility, the modeled water concentration was defined as the Reference Concentration (RC). The RC is a hypothetical initial benchmark concentration that would be diluted as the water volume in the open water basins changed during routine Filtration Facility operations. Potential dilution of the RC and comparison to established regulatory standards and guidelines for protecting drinking water (i.e., concentrations of concern) were detailed in the ancillary Graham Report (Graham 2022).

To determine the ESD, this report presents the results of AgDrift drift modeling and bystander exposure analysis for multiple pesticide active ingredients that are used on the surrounding lands of the Filtration Facility. Similarly, deposition of drifting pesticides onto the surface of open water basins will be estimated at 100 feet from spraying operations and the RC calculated. The ESDs will be examined in relation to distances on the proposed Filtration Facility site plan and the likely location of bystanders. The RCs will be compared to EPA safe drinking water standards and guidelines as well as any applicable Oregon standards (see the Graham Report). If ESDs represent distances less than the distances between surrounding farm and forest related pesticide applications and the Filtration Facility, then the County can confidently conclude that ORS 215.296 will be met and that farm and forest operations in the surrounding lands related to pesticide use would be unaffected by the Filtration Facility. Similarly, if RCs are below safe drinking water criteria for protecting human health, then the conclusion of no effect on present accepted farm or forest practices is also warranted.

1.3 Objectives

The overall goal of this risk assessment project is to estimate the probability of adverse impacts on agricultural and forestry operations in the surrounding lands of the Filtration Facility. The goal will be approached by using procedures consistent with the risk assessment paradigm routinely used by the EPA. The following tasks contribute to the project's goal.

- From a list of pesticide active ingredients derived from surveys of surrounding agricultural and forestry operations performed by the farm and forest experts evaluating the Filtration Facility (Globalwise Inc. and Mason, Bruce & Girard, Inc.), tabulate toxicological benchmarks needed for a risk assessment and identify the dosages recognized as safe by the EPA. These "safe exposure levels" are named the reference dose (RfD) or the related population adjusted dose (PAD), and each accounts for possible increased sensitivity of infants/children, nursing mothers, and senior citizens.
- Use product specimen labels to determine permissible per acre application rates of the pesticide active ingredients as well as permissible and prohibited practices that a pesticide applicator must follow under federal law. Accepted farm and forest practices only include compliance with these laws and permissible application rates and practices.
- Integrate the maximum permissible application rates of pesticides with the EPA's determination of human exposure dosages designated as the "safe exposure levels" to develop a hazard ranking of all pesticides that are used outdoors and therefore create a risk of drift.
- Use spray drift modeling to determine likely pesticide residues transported to adjacent properties with bystanders and/or water basins.
- Transform all residues into bystander body dose exposures and/or pesticide concentrations in water residues.
- Overlay safe RfD/PAD on bystander body exposures at specified distances from the edge of pesticide spray operations to determine an ESD.
- Establish a reference concentration (RC) for potential pesticide deposition into open water basins at a distance of 100 ft from a perimeter spray swath.
- Tabulate ESDs that would be protective of bystanders, using the legal paradigm of "reasonable certainty of no harm."
- Similarly, tabulate the RCs and compare them to drinking water quality criteria established to protect human health and make them available for predictions of how water level fluctuations in the water basins affect concentration.

2. Methodology for Data Collection and Analysis

Analyses for determining ESDs that protect bystanders from the possibility of drifting pesticides during an application in the surrounding lands relies on two main types of data:

(1) permissible per acre application rates, and (2) toxicological benchmarks used by EPA to determine when exposures might exceed their defined safety levels of concern (LOCs). Analyses for determining the RC also depends on delineating the permissible per acre application rates. This methodology section discusses the selection process for pesticide active ingredients most likely to drift from sites of application to surrounding properties and determination of EPA LOCs based on potential human exposures. After delineation of how these two essential types of data were obtained, the methodology focuses on using the AgDrift model to determine potential bystander exposures and RCs.

2.1 Selection of Benchmark Pesticides Used in the Surrounding Lands of the Filtration Facility

Pesticide use practices were surveyed by two farm and forest experts evaluating the Filtration Facility, Globalwise Inc. and Mason, Bruce & Girard, Inc., who developed a list of active ingredients and likely product formulations used in the surrounding lands of the proposed Filtration Facility specific to crops grown there and forest operations there. The farm expert and forest expert selected the chemicals for analysis after studying the accepted farm and forest practices in the surrounding lands and making inquiries of farm and forest users in the surrounding lands. From the maps of farm and forest land uses around the proposed facility (Figure 1), focus was concentrated on the nurseries which dominate the landscape immediately adjacent to the west and south all along the perimeter of the proposed Filtration Facility site. Importantly, the farm expert spoke to nursery growers, including a representative operating land immediately adjacent to the Filtration Facility site, to receive input on chemicals used in nursery operations in the surrounding lands. All chemicals identified by nursery growers, including a specific list of chemicals used adjacent to the site, were included in this analysis. Additionally included in the list were a broad set of representative chemicals from each chemical category (fungicides, insecticides, herbicides) based on industry publications and consultation with agricultural organizations. As noted elsewhere in this report, the wide diversity of types of chemicals, with different application rates and potential hazards, allows conclusions to be drawn regarding the use of alternative or newly registered chemicals that could be used in the surrounding lands now or in the future.

To the north-northeast sector of the property, steeply sloped forested areas dominate the landscape but are not in forest use. The closest large commercial forestry operations are more than 2.0 miles from the Filtration Facility site and thus too far away to be of concern, meaning beyond the 1000-foot distance over which the AgDrift model simulates drift. Notice of operations (NOAPs) filed for any forestry practices within two miles of the Filtration Facility were examined to determine pesticide use (Mason, Bruce & Girard 2022). Thus, any pesticides used in accepted forestry practices within the two-mile area around the Filtration Facility were included in a hazard ranking list owing to some active ingredients applied at comparatively higher per acre application rates than those used in agricultural operations.

Owing to the nursery practices for pest control having the highest probability of being affected by the proposed location of the Filtration Facility, all pesticides used outdoors (rather than in greenhouses or applied solely to plants growing within containers) were included for risk analysis. The list of pesticide active ingredients and their formulated products reported in the

surveys of accepted farm and forestry practices are presented in Table 1 with more details about agronomic uses described in Appendix A1.

The pesticides used in the surrounding lands are categorized as insecticides, herbicides, and fungicides. These types of chemicals are typically sprayed directly onto crops and/or soil for insect, weed, and plant disease control, respectively.

Two additional pesticide active ingredients (methyl bromide and chloropricrin) that may be used on surrounding agricultural lands are classified as fumigants and have dual purposes of weed and plant pathogen control. Fumigants are typically not used in accepted forestry practices. Fumigants are typically used before new perennial crops (e.g., fruit trees) and select field crops (e.g., potatoes) are planted. Fumigants are applied directly to soil by deep incorporation below the soil surface and often immediately covered with a tarp to prevent gaseous emissions beyond the area of application. When tarps are not used the soil must be immediately sealed and accepted practices generally include the use of a combination applicator and sealer implement. Thus, fumigant pesticides are not of concern for drift owing to the types of application equipment used for soil incorporation and sealing the soil. Therefore, accepted farming practices deploying fumigation will not be adversely affected by or conflict with the Filtration Facility.

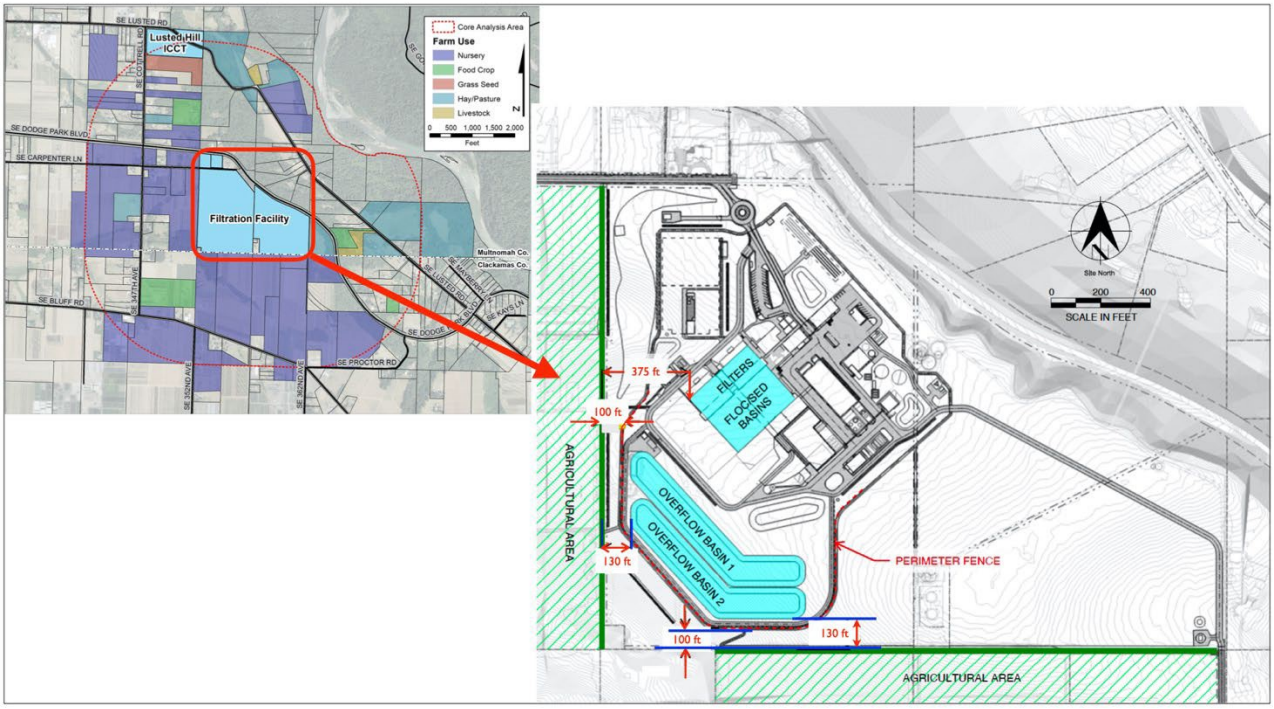

Figure 1. Map of Filtration Facility in relationship to the closest farm or forest land identified by land use.

Fertilizers are often applied to crops and trees as granular material rather than as liquid sprays. Regardless of whether in granular form or in liquid spray, fertilizers are applied around the root zone to individual plants or are directed in banded applications along the crop rows. Given the comparatively large size and density of the granules and the direct application to the root zone or rows, drift of the fertilizer particles is not expected. Furthermore, Oregon regulations for fertilizer use cover compositional characteristic and adulteration issues but do not address best application practices (OAR 603-059). Unlike pesticide products, fertilizers have no product label mandates that growers must follow, so accepted farm and forest practices related to the use of these products would not be affected by the location of the Filtration Facility.

When conducting pesticide risk assessments, EPA relies on application rates that pesticide registrants have assessed for pest control efficacy and have incorporated into the product labels as mandates that cannot be exceeded by pesticide users. Therefore, pesticide product labels for the listed active ingredients were used to determine maximum permissible rates of application on a per acre basis, which also defines the outer limit of accepted farm and forest practices for pesticides in the surrounding lands. Product formulations used in the surrounding lands were identified from grower interviews and included in this analysis. In the absence of identification of a specific formulation used in the surrounding lands, product labels were examined for permissible uses in nursery and other crops production occurring in the surrounding lands, and the most appropriate product formulation was selected for this analysis. The legally applicable product label defining specific use practices and prohibitions is the one accompanying a purchased pesticide. Generic specimen labels that are copies of the EPA-approved labels sold with the various pesticide formulations can be downloaded from the CDMS (Crop Data Management Systems, Inc.) online product database (cdms.net/LabDatabase), CDMS specimen labels were used for this analysis and also cross checked for current approved use in the EPA Pesticide Product and Label System Database (ordspub.epa.gov/ords/pesticides/f?p=PPLS:1).

Table 1 lists for each pesticide active ingredient, the product formulation name and associated label used to derive per acre application rates, and transformation of rates to units used for risk analysis.

Table 1. Pesticide active ingredients, commercial product formulations, per acre application rates (lbs/acre), and unit transformations (mg/m2) used in the risk analysis.

Pesticide Active Ingredient	Product Formulation	Maximum Application Rate (lbs/A)	Transformed Application Rate (mg/m^2)
	Insecticides		
Bifenthrin	Talstar S	0.200	22.4
Carbaryl	Sevin	2.000	224.0
Cyfluthrin	Decathlon 20WP	0.112	2.7
Fluvalinate	Mavrik Aquaflow	0.340	38.2
Imidacloprid	Marathon II	0.408	45.8
Permethrin	Perm-Up 3.2EC	0.400	44.8
Spinosad	Conserve SC	0.687	77.1
	Herbicides		
Aminopyralid	Milestone	0.109	12.3
Clethodim	Envoy Plus	0.243	27.2
Clopyralid	Transline	0.500	56.0
Dithiopyr	Dimension EC	0.500	56.0
Flumioxazin	SureGuard	0.380	42.6
Glufosinate	Finale	1.500	168.1
Glyphosate	Roundup Pro	3.750	420.3
Hexazinone	Velpar VU	4.000	448.3
Indaziflam	Marengo G	0.045	5.0
Isoxaben	Gallery 75DF	0.995	111.8
Oryzalin	Surflan AS	4.000	448.3
Oxyflurofen	GoalTender	2.000	224.2
Paraquat	Gramoxone SL2.0	1.000	112.2
Prodiamine	Barricade 4FL	1.500	168.1
Triclopyr BEE	Garlon 4	8.000	896.7
Trifluralin	Snapshot 2.5TG	4.000	448.3
	Fungicides		
Azoxystrobin	Heritage	0.250	28.0
Chlorothalonil	Bravo Ultrex	3.100	347.4
Fludioxonil	Medallion	0.680	76.2
Flutolanil	Prostar	2.930	328.4
Metconazole	Tournet	0.272	30.6
Myclobutanil	Eagle 20EW	0.250	28.0
Propiconazole	Tilt	0.220	24.7

2.2 Source of Toxicological Information: EPA Registration Decision Documents

EPA functions as a risk management agency under the statutory mandate of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. §136 *et seq.*) (7 U.S.C. §136 *et seq.*), first passed in 1947 and modified by several significant amendments since then. FIFRA gives EPA the authority to register pesticide products following an intensive risk assessment of the active ingredient (i.e., the chemical with designated pesticidal activity) to ensure a reasonable certainty of no harm from potential exposures to humans or other non-targeted organisms ("ecological receptors"). Registration of formulated products with the pesticidal active ingredient occurs after the agency completes its risk assessment, proposes a pesticide residue tolerance for any food uses, and validates a product label governing permissible and prohibited product uses.

The pesticide product label associated with each individual formulation has the force of federal law with the objective of protecting people who may come into contact with the pesticide, such as consumers or workers. Only once a pesticide product formulation is registered, a manufacturer may legally sell the pesticide and the product may legally be used in accepted farm and forest practices. Each formulation has a registration number and a number assigned to the facility that manufactures the product (i.e., an establishment number).

The concept of "reasonable certainty of no harm" was codified by Congress in the Food Quality Protection Act of 1996 which amended FIFRA and directed EPA to consider all exposure routes, including dietary, drinking water, and residential use scenarios (known as aggregate risk). Furthermore, the agency was directed to consider whether compounds could adversely affect endocrine physiology and whether children and nursing mothers were more susceptible than adults. EPA publishes its risk analyses and final decisions in the Federal Register (federalregister.gov).

The EPA Office of Pesticide Programs (OPP) is the agency's Division designated with the authority to conduct all risk assessments for chemicals designated as pesticides under FIFRA. EPA OPP decisions about pesticide registrations as well as pesticide assessment and enforcement policies are published in the Federal Register. Specific information about individual active ingredients can be accessed by searching an agency hosted database named Pesticide Chemical Search (ordspub.epa.gov/ords/pesticides/f?p=chemicalsearch:1). For every pesticide active ingredient, EPA publishes a detailed overview of findings for hazards to human health (as well as the environment). These risk analysis documents form the basis for the agency's registration decisions. Pertinently, registration decisions and associated support documents (e.g., the human health effects assessments) are first published as drafts that are posted to registrations.gov for a period of public comment. EPA will revise the draft when comments are cogent to ensuring a registration decision meets the standard of reasonable certainty of no harm.

Published EPA registration decision documents involving human health hazards were used to determine "safe exposure levels" (i.e., Levels of Concern [LOCs]) expressed quantitatively as RfDs/PADs) from both acute and chronic exposures. Acute exposure scenarios estimate likely exposure to a singular event such as spray drift. Chronic exposures estimate likely daily exposure over a 70-year life span, a typical assumption used in human health risk assessment and most applicable to dietary exposures from pesticide residues in food.

For each pesticide active ingredient listed in Table 1, EPA risk analyses for potential effects on human health were accessed and reviewed to obtain the agency's determination of exposures

that were considered to meet the standard of reasonable certainty of no harm that the agency designates as “levels of concern” (LOCs).

2.3 Determination of the Most Sensitive Toxicological Endpoint

The risk assessment paradigm used by the EPA OPP that contributes to pesticide registration decisions has been reviewed by the National Research Council (NRC), the research arm of the U.S. National Academy of Sciences (NRC 1983). EPA (2021) provides through their agency website an overview (summarized here) of how they conduct pesticide risk assessments and the types of data the agency relies on. Risk assessment is a four-step process: hazard identification, dose-response assessment, exposure assessment, and risk characterization (Figure 2). The hazard identification and dose-response assessment represent the toxicology information needed by EPA for incorporation into a formal risk analysis. EPA determines potential for exposure from various application and post-application scenarios, simplified as sources of pesticide residues from food, drinking water, and residential (non-occupational) use. Under FIFRA, companies seeking EPA registration of their pesticide products must submit to the agency raw data from experiments that address the hazard identification and dose-response assessment, i.e., the toxicological component of the risk assessment paradigm. EPA itself determines exposure potentials with the help of USDA and FDA databases of pesticide residues in foods and consumption surveys that estimate how much of different foods the U.S. population consumes. EPA determines drinking water exposure from computer simulation models grounded in environmental chemistry. Occupational and non-occupational exposure scenarios during pesticide applications and post-application periods are generated from specifically required studies submitted by the companies that are added to a dynamic database that EPA can use for any pesticide exposure scenario.

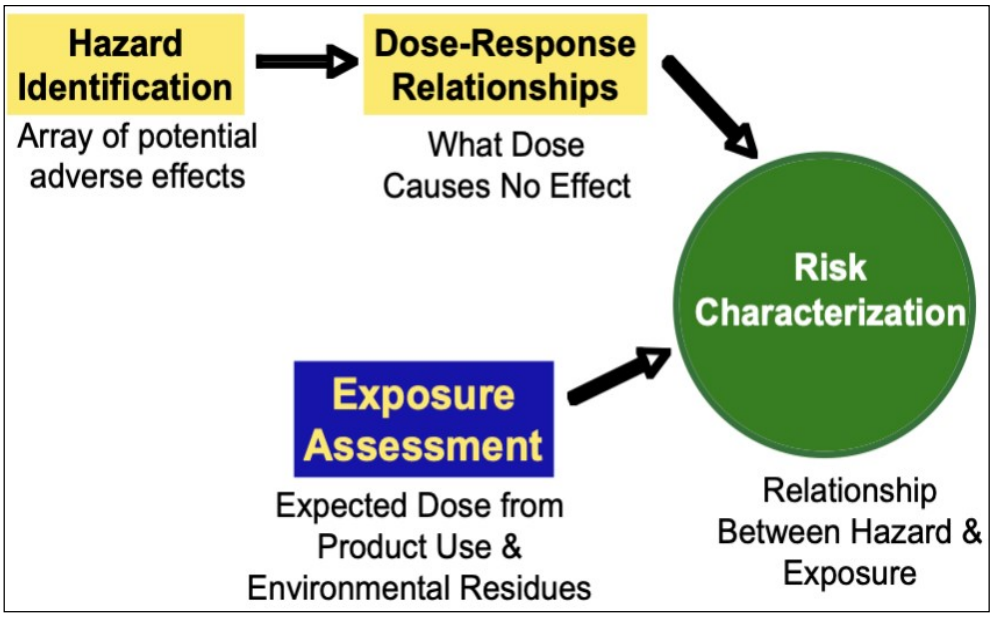

Figure 2. Concept map for the EPA risk assessment paradigm. The combination of hazard identification and examination of doses related to each hazard or doses not causing a defined hazard generate the toxicological information needed by the EPA to determine a protective LOC (level of concern). The exposure assessment process involves environmental chemistry to estimate or directly measure potential exposures. The dose-response relationships, in particular the NOAEL (no observable adverse effect level) and the exposure assessment are integrated to determine the risk.

The various toxicological experiments and occupational and residential exposure assessment that a company must submit to EPA are specified in the Code of Federal Regulations, Title 40, Chapter 1, Subchapter E, Part 158, Subpart F (Toxicology), Subpart K (Human Exposure), and Subpart L (Spray Drift) (ecfr.gov/current/title-40/chapter-I/subchapter-E/part-158?toc=1). For new pesticides under patent that have not been registered yet, EPA will rely on company data, but the agency validates the data quality and conducts independent quality assurance audits to ensure the data meet the Good Laboratory Practices standards embedded in FIFRA. Once a pesticide is registered, EPA must review periodically the registration decision considering any new data either submitted by the company or published in the scientific journal literature. Thus, in addition to relying on company registrant data to obtain toxicological information, EPA will conduct a thorough literature review of relevant toxicological studies for older pesticides that have already been marketed. Periodic pesticide reviews ensure any new hazard information will be considered for changes to the registration status of a pesticide and its product labels.

In the current version of Part 158, Subpart F, 29 different types of toxicological studies are listed that cover several basic areas of concern: acute toxicity (8 tests); subchronic toxicity (7 tests); chronic toxicity (2 tests); developmental and reproductive toxicity (3 tests); mutagenicity (5 tests); and a catch-all category called special testing that includes metabolism, dermal penetration, and immunotoxicity. Pertinently, public concerns about carcinogenicity are addressed in the two chronic toxicity tests, and endocrine system effects are deduced either from developmental and reproductive toxicity studies and/or specific tests done under EPA's Endocrine Disruptors Screening Program (EDSP). Guidelines for the required toxicological testing are published by the EPA under the rubric of Final Test Guidelines for Pesticides and Toxic Substances (epa.gov/test-guidelines-pesticides-and-toxic-substances/final-test-guidelines-pesticides-and-toxic). In addition to delineating guidelines for tests required under Subparts F, K, and L, the final test guidelines include 14 different tests that satisfy the requirements for the EDSP (epa.gov/test-guidelines-pesticides-and-toxic-substances/series-890-endocrine-disruptor-screening-program).

Under subpart F, EPA requires acute toxicity tests of doses causing mortality to the most commonly used test organism (a rat) via exposure by oral, dermal, and inhalational routes. Several doses are given one time to the test animal to determine the median lethal dose, known as the LD50 (the dosage by any route of exposure killing 50% of the test animals). Although the acute toxicity tests are not used by the EPA for risk assessment, they are used to place signal words on pesticide product labels as a way of indicating to the user a degree of hazard. The signal words are placed prominently on the front page of the product labels and constitute three degrees of hazard: danger, warning, caution. The hazard indicating signal words are based on the magnitude of the LD50 for each route of exposure (Appendix A2). Table 2 lists the oral, dermal, and inhalational LD50's of the pesticides used in the vicinity of the Filtration Facility and the known biochemical mechanism that results in death of the targeted pests (i.e., the mode of action). Safety data sheets for each pesticide product are the most likely source of information available to pesticide users, but they are not useful for understanding risks of an adverse physiological effects because exposure amounts are not integrated with the hazard.

EPA uses the raw data submitted by company registrants to determine the most sensitive sublethal hazards, meaning the toxicological effects that adversely affect physiology but do not cause death. Doses are purposely chosen to be sublethal, i.e., they are calibrated so as not to kill the organism but rather to determine subtle changes in biochemistry (e.g., blood, immune system parameters) and physiological processes. The most sensitive sublethal hazards are derived from exposure studies classified as subchronic and chronic. Subchronic studies expose animals to daily doses of pesticide dermally for 21-28 days and orally (via diet) for 90 days. Chronic exposure studies use a constant concentration of active ingredient in the diet for two

years (rats) or one year (dogs). The subchronic and chronic toxicology studies used for regulatory decisions typically consist of three dosages and a no-dose control administered to the test animals segregated by biological sex and held in individual cages. Pilot studies allow the experiments to refine dosages so at least the lowest and sometimes the middle dose is calibrated to produce no adverse effect in comparison to the non-dosed animals. The lowest test dose causing no effect is designated as the no observable adverse effect level (NOAEL). The dose where effects are significantly different than the non-dosed control group is called the lowest observable effect level (LOAEL). The highest dose tested is expected to result in adverse physiological effects in comparison to the control group of animals.

Table 2. Median lethal doses to test animals (LD50s) and pesticidal mechanism of toxicity (i.e., mode of action, MOA)

Pesticide Active Ingredient	Oral LD50 (mg/kg)	Dermal LD50 (mg/kg)	Inhalational LD50 (mg/kg) [1/]	Mechanism of Pesticidal Activity [2/]
	Insecticides			
Bifenthrin	43	2000	1617	axon sodium channel modulator
Carbaryl	303	2000	6872	acetylcholinesterase inhibitor
Cyfluthrin	590	5000	404	axon sodium channel modulator
Fluvalinate	261	2000	1051	axon sodium channel modulator
Imidacloprid	424	5000	10772	nicotinic acetylcholine receptor modulator
Permethrin	570	2000	4204	axon sodium channel modulator
Spinosad	2000	2000	10469	nicotinic acetylcholine receptor allosteric modulator
	Herbicides			
Aminopyralid	5000	5000	11116	auxin mimic
Clethodim	1360	5000	7882	acetyl CoA carboxylase inhibitor
Clopyralid	5000	5000	2021	auxin mimic
Dithiopyr	5000	5000	12086	microtubule assembly inhibitor
Flumioxazin	5000	2000	7943	protoporphyrinogen oxidase inhibitor
Glufosinate	3030	2000	8933	Glutamine synthetase inhibitor
Glyphosate	5000	5000	6427	enolpyruvyl shikimate phosphate synthase inhibitor
Hexazinone	1200	5278	7963	photosystem II inhibitor
Indaziflam	2000	2000	4648	cellulose synthesis inhibitor
Isoxaben	10000	2000	4022	cellulose synthesis inhibitor
Oryzalin	5000	2000	6407	microtubule assembly inhibitor
Oxyfluorfen	5000	2000	7498	protoporphyrinogen oxidase inhibitor
Paraquat	283	2000	2	photosystem I electron diversion
Prodiamine	5000	2000	517	microtubule assembly inhibitor
Triclopyr BEE	803	2000	9701	auxin mimic
Trifluralin	5000	2000	9418	microtubule assembly inhibitor
	Fungicides			
Azoxystrobin	5000	2000	1411	mitochondrial complex III cytochrome bc1 inhibitor
Chlorothalonil	5000	5000	24	multisite contact activity
Fludioxonil	5000	2000	5327	MAP/histidine kinase in osmotic signal transduction
Flutolanil	10000	5000	1031	mitochondrial complex II succinate dehydrogenase inhibitor
Metconazole	566	2000	11318	C14 demethylase in sterol biosynthesis inhibitor
Myclobutanil	1600	5000	10307	C14 demethylase in sterol biosynthesis inhibitor
Propiconazole	1517	4000	11803	C14 demethylase in sterol biosynthesis inhibitor

1/ LD50s for inhalational exposure are reported as concentration of active ingredient in air, i.e, mg active ingredient per liter of air (mg/L). However, this concentration term can be expressed on a whole body dosage basis like the oral and dermal LD50 (i.e, mg/kg body weight) by consideration of the volume of air ventilated during a 24 hour period. These units were transformed to body dosage units of mg/kg/d by assuming a 2-year old child ventilationrate (95th percentile, 0.016 m3/min, scaled to 24 h) and a body weight of 11.4 kg (EPA 2008).

2/ Biochemical mode of action terminology based on the characterization used by the Insecticide Resistance Action Committee (https://irac-online.org/mode-of-action/), the Herbicide Resistance Action Committee (https://hracglobal.com/tools/hrac-moa-2020-revision-description-and-master-herbicide-list), and the Fungicide Resistance Action Committee (https://www.frac.info/fungicide-resistance-management/by-frac-mode-of-action-group). The recognized modes of action are used by the EPA when validating pesticide product labels to inform users for purposes of managing development of pest resistance.

Finding physiological effects at the highest doses is not unusual for any naturally occurring or synthetic compound in regulatory testing procedures because the most used subchronic and chronic tests employ constant daily dietary dosages for prolonged periods. Daily dietary exposure studies are protective of consumers presumed to daily eat food containing pesticide residues, estimated as contributing about 80% to overall lifetime exposure. In addition to dietary (i.e., oral) exposure tests, shorter term dermal exposure only tests (typically 21-28 days) are required so that EPA can assess potential effects of direct pesticide spray drift on bystanders or workers. Assurance that the most vulnerable demographic populations, infants, children, and nursing mothers, are protected is addressed by the required developmental and reproductive toxicology studies. Developmental studies dose rodent females during gestation via intubation or gavage (direct delivery of the dose to the stomach) and reproductive toxicity studies expose parents and at least one generation of offspring via diet, drinking water, or gavage.

From the array of studies, EPA will choose most often the 90-day subchronic dietary studies or sometimes the 21-28 day dermal exposure study to represent an acute exposure. For consumers, an acute exposure is defined as the pesticide residues on food consumed by a person during a 24-hour period. For residential (i.e., non-occupational) and worker (occupational) pesticide use, the equivalent of an acute exposure is denoted as “short-term” with an interval ranging from 1-30 days. EPA will also examine risk to residents and workers after applications have ceased and a person may inadvertently contact pesticide residues on surfaces such as vegetation.

The longer-term chronic exposure studies generate data that EPA uses to determine effects over a lifetime of exposure. Chronic toxicity studies involve daily dosing of test animals for one year (dogs and mice) to two years (rats). Lifetime exposures are applicable to consumption of food that is presumed to have pesticide residues. Intermediate term exposures greater than 30 days are applicable to occupational use of pesticides. Under the Food Quality Protection Act, EPA must make determinations of risk by aggregating exposures from diet, drinking water, and residential (non-occupational) uses.

The particular study that EPA uses to assess acute and chronic exposure will be based on what adverse effects occur at the lowest tested doses in comparison to the non-dosed control animals. EPA will then choose from those studies the dose corresponding to the NOAEL. Sometimes, EPA will take the results of a study and extrapolate from the array of doses a statistical estimate of a NOAEL, which is then called the Point of Departure (POD). However, often the POD and NOAEL (which is an empirically observed dose) are the same.

With the NOAEL, EPA will apply up a 100-fold safety factor (also known as uncertainty factors, UF) to generate the equivalent of a safe level of exposure denoted as the Level of Concern (LOC). The LOC represents a dose that the agency is confident poses a reasonable certainty of no harm. If EPA decides that infants and children may be more vulnerable to a lower dose than

that of an adult, the agency is authorized under the Food Quality Protection Act (FQPA) to use, and will apply, up to an additional 10-fold safety factor. The LOC is called either the acute Reference Dose (aRfD) or the chronic Reference Dose (cRfD) for shorter term and longer term exposures, respectively. When EPA applies an extra safety factor above the default 100 fold factor, then the RfD changes into the Population Adjusted Dose (PAD). Often, however, the RfD and PAD are identical, and herein forward in this report, all LOCs will be named as either the aPAD or the cPAD. EPA concludes that a risk from pesticide exposure is of no concern when estimated exposures from any source do not exceed the PAD.

Occasionally, EPA will review the published primary research literature to obtain doses the agency considers even more protective than the doses in studies submitted by industry. For example, for three of the insecticides covered in this risk analysis (bifenthrin, cyfluthrin, and permethrin), EPA chose to use a POD dose derived from a published experiment (EPA 2019a; EPA 2020a,b; Walansky et al 2006). For more established compounds, EPA will sometimes use a Physiologically Based Pharmacokinetic (PBPK) model based on human physiology to estimate the dose related to a toxicological adverse effect (e.g., carbaryl, EPA 2021). In that case, EPA will lower its safety factor to 10 because relying on human data in contrast to rodent data provides more confidence that exposure meets the legal standard for safety.

The data needed for this risk analysis are embedded in those toxicological studies under the requirements of Subpart F. The most relied upon toxicological studies used by EPA to determine the PADs are either subchronic or chronic dietary studies.

Reliance on the subchronic toxicity studies is highly conservative when estimating safety to bystanders from use of pesticides. Spray drift is a “fast” phenomenon, meaning potential exposure occurs from a highly diluted spray that occurs over an interval of seconds, not days. Thus, the aPAD for single or short-term exposures was used for risk analysis to determine ESDs associated with risk to bystanders from potential drift from pesticide applications.

Because bystander exposure from drift occurs on the exposed skin surface, and the most sensitive toxicological endpoints or hazards are obtained from longer-term daily dietary exposure studies, EPA will adjust the safe exposure levels by dermal adjustment factors (DAF). DAFs are derived from dermal penetration efficiency studies that manufacturers submit to the EPA. DAFs correct skin surface exposures by the percentage of chemical that is likely to move over a 24-hour period through the protective barrier of the epidermis (i.e., the stratum corneum) into the dermis tissue containing the blood capillaries. In some cases, EPA will waive the need for dermal penetration factors when toxicological studies show no hazards from dermal exposure studies at the highest tested doses. In this risk analysis, EPA’s aPADs were modified by the DAF to provide a realistic exposure scenario to bystanders.

Table 3 details the toxicological endpoints (NOAELs and aPADs) and DAFs delineated in EPA registration decisions documents for the pesticides listed in Table 1. When the EPA stated no DAF was available from submitted studies owing to lack of dermal toxicity, the published research literature was searched for a dermal penetration study (e.g., spinosad). The referenced EPA documents detail the toxicological effects that formed the basis of the agency’s decision to choose the studies that would be most protective of all demographic population groups.

Table 3. EPA defined toxicological parameters used for conducting risk analysis

Pesticide Active Ingredient	NOAEL (mg/kg/day)	aPAD (mg/kg/day)	Dermal Absorption Factor	EPA Registration Document
	Insecticides			
Bifenthrin	3.1	0.031	0.01	EPA 2020a
Carbaryl	4.2	0.042	0.12	EPA 2021
Cyfluthrin	1.2	0.012	0.0056	EPA 2019a
Fluvalinate	1.0	0.010	0.04	EPA 2019c
Imidacloprid	8.0	0.080	0.0720	EPA 2017b
Permethrin	44.0	0.440	0.0330	EPA 2020b
Spinosad	4.2	0.042	0.01 2/	EPA 2016
	Herbicides			
Aminopyralid	104.0	1.040	NE 3/	EPA 2020d
Clethodim	100.0	1.000	0.284	EPA 2014c
Clopyralid	75.0	0.750	NE 3/	EPA 2019h
Dithiopyr	5.0	0.050	NE 3/	EPA 2020c
Flumioxazin	3.0	0.030	0.080	EPA 2019e
Glufosinate	6.3	0.063	0.09	EPA 2012
Glyphosate	100.0	1.000	NE 3/	EPA 2017e
Hexazinone	125.0	1.250	NE 3/	EPA 2015
Indaziflam	7.5	0.075	0.073	EPA 2017d
Isoxaben	200.0	2.000	0.230	EPA 2010
Oryzalin	25.0	0.250	0.023	EPA 2017c
Oxyfluorfen	183.0	1.830	0.180	EPA 2019i
Paraquat	5.0	0.050	0.003	EPA 2019b
Prodiamine	14.0	0.140	0.030	EPA 2018b
Triclopyr BEE	100.0	1.000	0.017	EPA 2019f
Trifluralin	100.0	1.000	0.030	EPA 2018c
	Fungicides			
Azoxystrobin	67.0	0.670	0.042	EPA 2018a
Chlorothalonil	60.0	0.600	0.110	EPA 2021c
Fludioxonil	50.0	0.500	NE 3/	EPA 2017a
Flutolanil 1/	50.0	0.500	NE 3/	EPA 2014a
Metconazole	12.0	0.120	0.160	EPA 2014b
Myclobutanil	60.0	0.600	0.500	EPA 2019d
Propiconazole	30.0	0.300	0.260	EPA 2006

1/ EPA did not establish an aPAD for flutolanil. In the registration documents for flutolanil, EPA stated, "Based on the available toxicological data, no observed toxic effects could be attributed to a single, short- or intermediate-term oral exposure. Likewise, no observed toxic effects could be attributed to dermal exposures of any duration." Therefore, for risk analysis, the flutolanil cPAD shown in the Table was used.

2/ EPA did not establish a DAF for spinosad but regulatory evaluations by the Food and Agriculture (FAO) division of World Health Organization's Joint Meeting on Pesticide Residues (JMPR) committee reported that a pharmacokinetic study observed 1% dermal absorption in 24 h (FAO/WHO 2001). Furthermore, short-term dermal application of spinosad as a drug for treatment of head lice found no evidence of systemic exposure (McCormack 2011). Thus, dermal penetration over 24 h was <1%, and 0.01 was adopted as the DAF.

3/ NE = EPA did not establish a DAF, usually because of lack of an acceptable study.

2.4 Hazard Ranking Methodology

A hazard ranking procedure was developed that integrated label-based maximum application rates on a per acre basis with EPA's defined PAD for acute or short-term exposure to bystanders and pesticide users. The hazard ranking defined which pesticides would likely be of most concern in the event of inadvertent exposures to people during spraying operations. Furthermore, ranking a wide diversity of pesticides having a wide range of properties and studied toxicological effects can be useful to predicting whether use of future new or different than reported pesticide products could be impacted by the Filtration Facility siting. EPA registration documents reporting human health hazard and risk assessments for each chemical were scrutinized to determine EPA's designation of the specific toxicological studies used to determine the most sensitive NOAELs and subsequent transformation with safety factors to the LOCs (i.e., the aPAD) (Table 3). All PADs are expressed in terms of body dosage as mg active ingredient per kilogram of body weight per day (mg/kg/d). The most pertinent routes of exposure for nearly all pesticides that EPA analyzes are dietary (food and water) and dermal (skin exposure). Subpart F requires submittal of an inhalational exposure study but unless the inhalational hazards are deemed more sensitive than the dietary and dermal exposure studies (i.e., they occur at lower body doses), EPA infrequently uses inhalational toxicology studies to determine the most sensitive endpoint. Inhalation of pesticide residues from air, even during occupational (worker) uses, is a minor exposure route compared to dermal exposures (Baharuddin et al 2011; Cao et al 2015, 2017; Flack et al 2008; Tsakirakis 2014).

Product labels associated with the commercial formulations of each pesticide were obtained from the CMDS database and validated against the EPA Pesticide Product and Label System database to determine the maximum allowed application rates (previously shown in Table 1). The application rates, typically expressed as pounds of active ingredient per acre, were transformed to mg/m^2 units. The PADs were transformed to a whole-body surface area dosage by assuming the bystander is a 2-year-old child weighing 11.4 kg with a surface area of 0.61 m^2. Standard body weights and surface areas were obtained from the EPA Exposure Factors Handbook (EPA 2008, 2011). Under the mandates of the FQPA, EPA was charged specifically with protecting children and a two-year old is the typical age demographic used as the model for risk assessment. A child has a greater surface area to body mass ratio than an adult and thus potentially has a greater dermal exposure. Thus, using a two-year old body surface area introduces a more protective standard than just relying on the adult body.

The hazard rating (HR) for each pesticide used in the surrounding lands of the Filtration Facility was calculated as the ratio of the surface area transformed PADs (mg/body m^2) relative to the product application rate (mg/field m^2) (Equation 1, 2; Appendix A3).

$$\text{Hazard Rating (HR)} = \text{application rate} / [(\text{aPAD} \times \text{body weight/day})/\text{body surface area}] \quad (1)$$

$$HR = mg/m^2 / [(mg/kg/day\ bw) \times kg)]/m^2] = HR\ units/day \quad (2)$$

Figure 3 presents graphically the order of hazard based on the integration of aPAD and application rate. The hazard ranking shows that just relying on toxicological parameters alone can be misleading in determining which pesticides might be of most concern. By incorporating application rate, compounds of comparatively lower toxicity are placed into a more proper perspective regarding risk of adverse effects. Thus, the hazard ranking procedure incorporates an element of potential exposure by integrating application rate. The top ten pesticides with the highest hazard ranking include three insecticides and seven herbicides. Although herbicides (with the exception of paraquat) are considered less hazardous than insecticides because they target specific plant metabolic processes absent in animals, their often-higher rates of application can change the perspective of their risk, especially when hazards are identified from long term dietary feeding studies, not acute exposure studies that are more applicable to characterizing drift events.

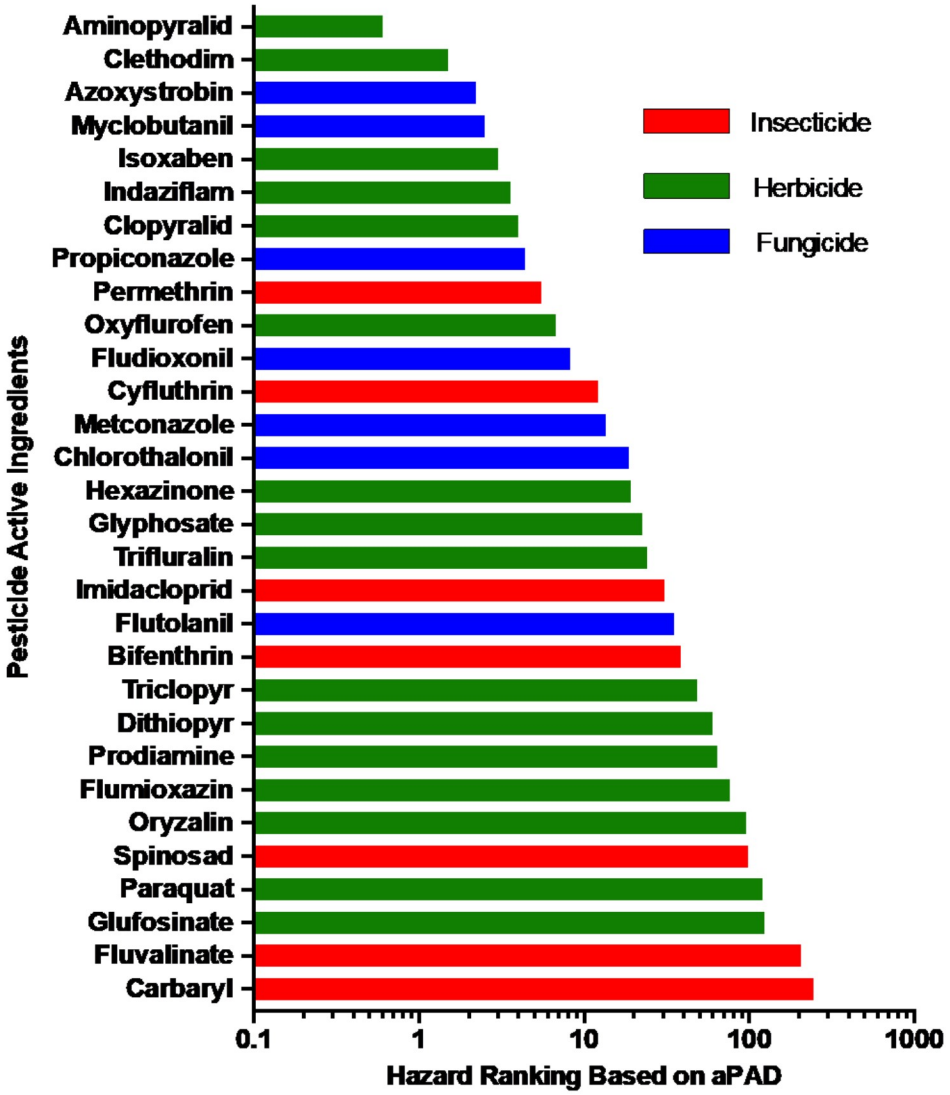

Figure 3. Hazard ranking of pesticides used on the lands surrounding the Filtration Facility.

2.5 Spray Drift Determination—AgDrift Modeling

For estimating environmental residues that workers or bystanders may come in contact with or may deposit in water during spraying, EPA uses a publicly available computer simulation model named “AgDrift” (EPA 2022a) to predict pesticide residue concentrations at various distances from a sprayed crop. Felsot et al. (2003; 2004; 2010) published an overview of the basic procedure for using AgDrift output to estimate potential exposures to humans during spraying operations and deposition into streams.

AgDrift consists of modules for estimating spray drift at various distances downwind of 1-20 sprayed crop rows. Each crop row is approximately equal to the width of spray emitted from a single nozzle, which is considered a single spray swath. Thus, AgDrift predicts spray drift from a single spray swath up to 20 aggregated spray swaths. AgDrift simulates three main types of application equipment or spray scenarios: aerial spraying (fixed wing or helicopter); air- blast sprayers (used in orchards, vineyards, and nurseries during plant dormancy or in full canopy, most commonly with axial fan airblast sprayers); and ground boom sprayers (commonly used in grain, cereal, and vegetable crops). The sprayers are pulled by tractor up and down the crop rows. The axial fan airblast sprayer module in AgDrift can approximate other sprayers (e.g., the cannon sprayer) that emit the spray through a small orifice with fans generating a high velocity wind pushing the spray droplets into the canopy (Figure 4). The modules chosen for this analysis predict spray drift for all types of application equipment or spray scenarios used in accepted farm or forest practices in the surrounding lands, based on the surveys and analyses of surrounding agricultural and forestry operations performed by the farm and forest experts evaluating the Filtration Facility (Globalwise Inc. and Mason, Bruce & Girard, Inc.). Teske et al (2002) published an overview of operational aspects of AgDrift and history of model development, especially for aerial applications of pesticides. Hewitt et al. (2000; 2001) have described the empirical studies used to form the database that drives the model for ground sprayers.

Figure 4. Ground boom sprayer (A,B) used for cereal, grain, and vegetable crops and axial fan airblast sprayer (C,D) used for perennial crops in orchards, vineyards, and nurseries. The boom sprayer simulation for this analysis was run for both low boom (recommended best management practice, B) and high boom (48-50 inches). The airblast sprayer assumed application to a dormant crop canopy (C) and a fully leafed out canopy (D). (Picture credits: A,B from youtube.com/watch?v=4i4a9S0ZpzI; C from canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/growers-commercial-users/drift-mitigation/management-pesticide-spray-drift.html; D from 123rf.com/photo_59922226_air-blast-sprayer-with-a-chemical-insecticide-or-fungicide-in-the-orchard.html)

AgDrift simulates a worst-case scenario by assuming the terrain is flat, and no vegetation or other structures intercept the spray until it falls vertically to the crop canopy or non-targeted area, bystander, or water body (Figure 5). Furthermore, AgDrift assumes the most conservative possible constant atmospheric conditions where any wind is blowing perpendicular to the direction of any spray swath across a row. Note in Figure 5 that the field application rate (FAR) depositing in the crop rapidly declines immediately beyond the last sprayed crop row. Empirical testing of AgDrift has indicated that the model overestimates deposition of pesticides downwind in comparison to actual field measurements (Perine et al. 2021). Thus, AgDrift is more likely to estimate greater exposure than might occur, and therefore the model is likely to overestimate bystander exposure and residues that might land on water surfaces, resulting in an extremely risk-conservative analysis.

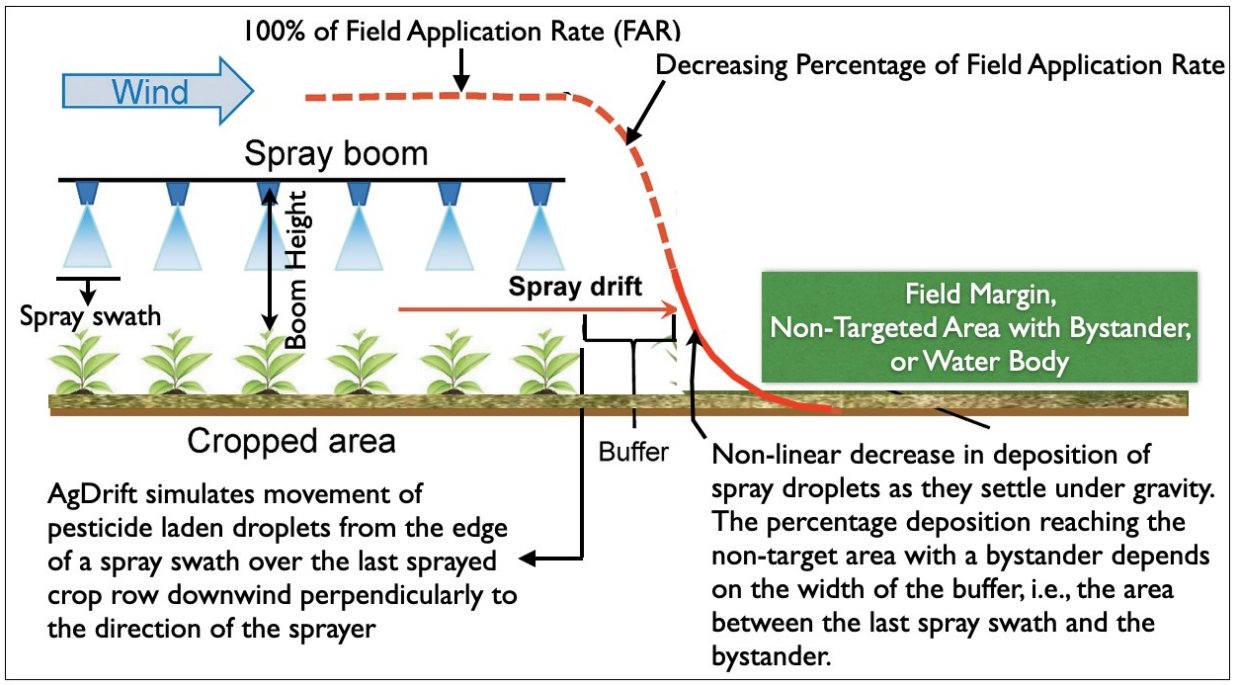

Figure 5. Schematic of AgDrift modeling of spray drift from a ground boom sprayer moving in an air mass perpendicular to the direction of sprayer travel. Schematic was modified from Smith et al. (2021) with the addition of explanations for AgDrift modeling, spray drift deposition characteristics, definition of the spray swath, and indication of the non-target area for consideration of exposure risk. Actual spray drift would be affected by terrain, vegetation, or other structures in the buffer area which intercept spray before it falls vertically to the ultimate area of deposition.

Agricultural land use near the Filtration Facility is dominated by nurseries growing a combination of ornamental plants and fruit trees. Additionally, vegetable or small fruit farms are also nearby. Thus, AgDrift modeling to estimate downwind deposition of sprayed pesticide residues used the modules for ground boom sprayers and airblast sprayers, the two types of application equipment / spray scenarios used in these accepted farm practices.

The ground boom and airblast sprayer modules of AgDrift were developed from empirical studies that were statistically manipulated to derive the 90th percentile of deposition downwind from the last spray swath. The ground boom modules simulate downwind deposition of spray aerosols generated from two different boom heights, 2 ft and 4 ft. Greater downwind deposition

occurs the higher the boom height above a crop canopy or soil surface. Therefore, both boom heights were modeled in this analysis, with the latter higher boom height providing greater conservatism in estimating risk of exposure. Similarly, the airblast sprayer modeling used both the full canopy and dormant canopy options with the latter being more conservative in estimating risk. Spray drift deposition was assumed to be generated by 20 swaths across a field (the model maximum) because a greater mass of pesticide drifts from a field with more spray swaths and therefore ensures a more conservative estimate of potential exposure risk.

For ground boom sprayers, AgDrift was used to model two spray quality scenarios that are defined by the range of spherical diameters of the aerosols (or spray particles) created by the emission nozzles. Risk analysis was applied to spray quality scenarios characterized as 'very fine to fine' and 'fine to medium coarse'. The American Society of Agricultural and Biological Engineers (ASABE) has standardized the definitions used for spray quality assessment in a standard titled ASABE S-572.3 (ASABE 2020). The 'very fine to fine' scenario represents the greatest potential for drift because the VMD (volume median diameter) has comparatively greater volume of smaller spray particles than the 'fine to medium coarse' spray scenario and thus droplets move greater horizontal distances before falling 10 vertical feet from the point of delivery. For airblast sprayers, AgDrift was used to model sprays in both the more conservative option, a dormant season canopy when trees do not have leaves, and during the growing season, when tree leaves have fully developed (i.e., full canopy).

The pesticide residues moving off field in drift (i.e., during a spraying event) were assumed to either deposit directly on a child's exposed skin or on the surface of an open water body. Thus, for each of these non-target scenarios, pesticide residues were transformed into potential body dosages or into residue concentrations in water.

2.5.1 Determination of Bystander Exposure to Potential Drift

The output of AgDrift modeling was tabulated as the percentage of initial spray deposited just beyond the edge of a spray swath and the percentage deposited on the ground downwind to a distance of 1000 ft (Figure 6). Modeling output was uploaded to an EXCEL spreadsheet for transformation from percentage deposition of spray droplets at distance to a body dosage, assuming that a bystander was in the path of the drifting spray. Pertinently, for each application scenario (i.e., airblast sprayer, ground boom sprayer) the percentage of the pesticide spray depositing was the same, but the mass of active ingredient deposited over distance varied according to the specific maximum application rate for each pesticide. To determine body dosage, the first step was to multiply the pesticide product labels' maximum permissible application rate (expressed in units of mg pesticide per square meter, mg/m^2) by the fractional deposition of spray drifting downwind of a spray swath made over the perimeter crop row.

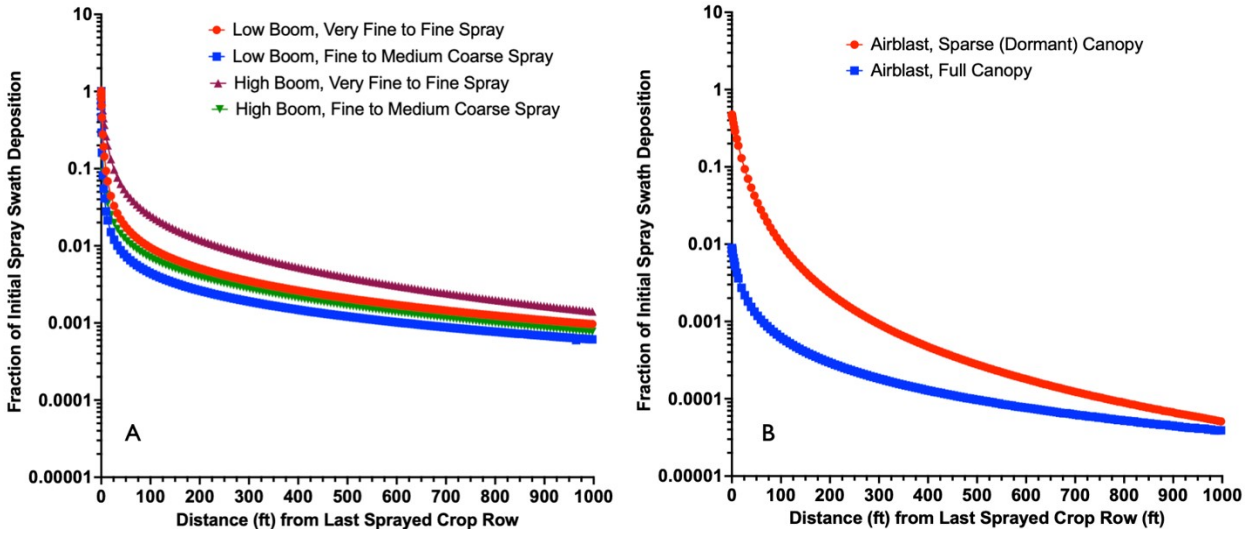

Figure 6. Fractional deposition of pesticide residues downwind of a spray swath. 'A' represents AgDrift modeling of fractional deposition from a ground sprayer boom at two heights above the ground or canopy and two spray qualities. 'B' represents the fractional deposition from an axial fan airblast sprayer operating in a dormant orchard without leaves and a full canopy orchard.

The second step to determine body dosage was to adjust the mg of active ingredient depositing on one square meter to the skin surface area of a bystander with exposed head, arms, hands, and legs. The body characteristics of a two-year old child was assumed to be the target bystander potentially exposed to drift during a pesticide spraying operation. The EPA Child-Specific Exposure Factors Handbook catalogs distributions of body surface areas and body weights for different demographic groups (EPA 2008). Thus, using a child's body weight (11.4 kg) and exposed body surface area (i.e., 0.356 m^2, the aggregated surface area of the head, arms, hands, and legs) produces the most conservative analysis of risk of potential exposure during a spraying operation that would meet EPA's LOC for determining a "reasonable certainty of no harm." The final body dosage to a child was adjusted by the DAF, a procedure that EPA uses to transform a dosage from an oral (i.e., dietary) toxicological study to a dermal exposure. The use of the exposed body surface of a child with transformation of the deposited pesticide residue by the DAF represents a conservative environmental scenario for possible exposure from spray drift.

The potential body dosage from spray drift was modeled for all application scenarios from tractor drawn ground boom sprayers and axial fan airblast sprayers. However, herbicides are not applied via airblast sprayers, so exposure characterization only included the scenarios with ground boom sprayers. After the transformation of spray drift to a body dosage of a two-year old child, data were tabulated and graphed with an overlay of the aPAD that corresponded to EPA's exposure levels of concern (LOCs). Body dosages less than the LOC can be thought of as a safe level of exposure because it would meet EPA's standard for determining a reasonable certainty of no harm. Notably, use of the aPAD to represent the LOC for a single or short-term exposure produces a conservative risk estimate because EPA most often develops that parameter from longer term exposure studies ranging most often from 90 days to two years of daily exposures to the same pesticide dose. Furthermore, for some of the pesticides, EPA decided to use the same safe exposure level for both the acute and the chronic exposure scenario.

2.5.2 Determination of Pesticide Residues Potentially Drifting to Open Basins

Because the Filtration Facility treatment process includes basins which are open to the atmosphere, an analysis of potential pesticide residues from spray drift landing on a basin surface were estimated using AgDrift. The objective for this analysis was to estimate what concentration of pesticide residues (expressed as micrograms per liter, µg/L) might result from spray drift at 100 feet from the perimeter crop row during a spraying operation. Because the maximum permissible application rate was expressed on a surface area basis (i.e., mg/m^2), the drifting pesticide residues were assumed to land on the water surface and instantaneously mix throughout the water. Thus, the application rate expressed in terms of mg of pesticide landing on a water body was transformed into the mass mixing into a concentration.

Pertinently, the concentration of pesticide derived from AgDrift modeling represented the initial concentration in a hypothetical ten-foot deep body of water, but does not account for the large dilution of the basin volume with incoming water not exposed to the open air. Thus, the actual concentration of water moving through the process train would be much lower than the initial concentration and can be predicted knowing the flow rate of water through the holding basins. To facilitate modeling of the effect of dilution on pesticide concentrations that may result from deposition on water surfaces, the concept of a reference concentration (RC) was developed as the initial pesticide concentration that might result from deposition of drifting residues at a distance of 100 feet from the perimeter crop row. The 100-ft distance is approximately the minimum distance between an adjacent property line and the perimeter fence of the Filtration Facility. To ensure a conservative analysis, the 100-ft distance is well below the mapped 130 ft distance from the adjacent property line to the nearest open basins at the Filtration Facility (Figure 1). Thus, the RC represented the estimated worst case initial pesticide concentration in a ten-foot deep body of water in an open basin at the Filtration Facility. The RC was then used in the Graham Report to estimate any residual levels of pesticide that could hypothetically be present in finished water from the Filtration Facility, taking into consideration water volume and filtration operations (Graham 2022).

The significance of the RC with respect to drinking water safety was clarified by comparing the resulting concentration to EPA's published water quality standards and guidelines for protecting human health (see Graham 2020). Those standards and guidelines, published as the "Human Health Pesticide Benchmarks" (EPA 2021d), as "Health Advisories" (HA) (EPA 2018), or as "Maximum Contaminant Levels" (MCL) (EPA 2018) are equivalent to LOCs for drinking water consumption but expressed as concentrations in water (e.g., as micrograms of pesticide per liter, µg/L) rather than as body dosages (mg/kg/day). The resulting RCs were ranked in the Graham Report (Graham 2022) by their percentage of the regulatory standard and guidelines to differentiate their water quality significance from the rankings based on direct human exposure.

2.6 Criteria for Determining No Significant Changes to or Increased Costs of Accepted Farm and Forest Practices and No Detrimental Effect on Filtration Facility

EPA does not regulate pesticides for zero exposure but instead ensures a reasonable certainty of no harm if exposed by any route, i.e, dietary, oral, dermal, or inhalational. The objective of this drift analysis is to estimate bystander exposure to drift and potential residues in the water basins and then determine if resulting bystander exposure or water quality would exceed EPA's standards for reasonable certainty of no harm (as explained above, the aPAD), or regulatory water quality standards and guidelines protective of human health. Thus, if any estimated exposure did not exceed those standards or guidelines, then accepted farm and forest practices for pest management would not be adversely affected (i.e. would not force a significant change in or significantly increase the cost of those practices) by siting the Filtration Facility near that farm or forest land and surrounding agriculture/forest uses of pesticides would not be detrimental to the Filtration Facility or drinking water quality.

To characterize whether potential exposures exceeded EPA's LOCs, drift-exposure output was examined for crossover with the aPAD. That point of crossover is specifically defined in this report as the "equivalent safe exposure distance" (ESD). The ESD represents a bystander's distance from a spray swath where, if they were exposed to drifting spray droplets, the body dosage would not exceed EPA's levels of concern. To ensure that farm and forest practices would be unaffected by the Filtration Facility, the distance separating a potentially sprayed crop row and the bystander areas of the proposed Filtration Facility (inside the perimeter fence, as described below) must be greater than all ESDs for pesticides used on surrounding farm and forest properties. Similarly, considering the distance from a potential spray of pesticides and the open water basins at the Filtration Facility, the pesticide concentration in finished water from the Filtration Facility should not exceed regulatory water quality standards and guidelines.

According to the proposed site map of the Filtration Facility, a distance of approximately 130 ft at minimum will separate an adjacent property line and the open water basins (Figure 1). This distance exceeds the approximately 100 ft distance between an adjacent property and the perimeter fence of the facility. Bystanders could be located anywhere on the facility side of the perimeter fence line. Thus, if ESDs did not exceed 100 ft and residual pesticides in finished water could be shown to be below regulatory drinking water standards and guidelines, then the conclusion of this analysis would be that farming and forest practices for pest management are not adversely affected by the location of the Filtration Facility and surrounding agriculture/forest uses of pesticides would not be detrimental to the Filtration Facility or drinking water quality.

A second criteria was used to ensure that farm and forest practices for pest management would not be adversely affected by the location of the Filtration Facility. All pesticide product labels were examined for mandatory language regarding buffer zones that must be maintained to protect sensitive areas, such as water resources. The buffer zones, also known as "application exclusion zones" (AEZ) are the responsibility of the pesticide user to adhere to. Therefore, as the second criteria for concluding that accepted pest management practices involving pesticide use would not be affected by the Filtration Facility, product labels with AEZs were closely scrutinized to ensure the mandates could continue to be met by pesticide users.

3. Risk Analysis Results

The goal of this risk analysis was to determine whether accepted farm and forest practices would be impacted by proximity to the Filtration Facility and whether such practices would be detrimental to the Filtration Facility or drinking water quality. The risk analysis was conducted under EPA's presumption that some de minimis level of drift is unavoidable. The question to resolve was whether drift resulting in exposure to bystanders at the Filtration Facility or potential drift onto the water basins would exceed EPA's defined human health LOCs or drinking water standards and guidelines at the distances separating the farm and forest operations from the bystander areas and open water basins at the Filtration Facility. This section will first review AEZ mandates of the pesticide product labels that pesticide users are obligated to follow under federal law and compare those AEZs to the distances to the bystander areas and open water at the Filtration Facility. Next, the ESDs from AgDrift modeling for exposure downwind of a spraying operation are presented to compare to the distances to the bystander areas within the Filtration Facility. Thereafter, deposition of pesticide residues onto a water body 100 feet from a sprayed crop row (defined as the RC) are shown for two herbicides as an example of the transformed AgDrift output and the relationship to water quality standards or guidelines are discussed in the Graham Report (Graham 2022).

3.1 Characterization of Pesticide Use and Product Label Mandates

As described above, agricultural and forestry landowners and/or managers and other local experts were surveyed to obtain information about specific pesticides being used for crops grown in the surrounding lands of the proposed Filtration Facility. Appendix A1 lists Information about the pesticide classes, their use, and targeted pests. Appendix A4 summarizes pertinent information on the product labels that are mandates that the pesticide user must follow.

Product labels for all of the identified active ingredients were reviewed to characterize allowable uses and prohibitions applicable to the agricultural and forestry pest management practices in the surrounding lands of the planned Filtration Facility. Under FIFRA, product labels have the force of federal law, and thus pesticide users must strictly follow application allowances and restrictions. Use of pesticides that does not strictly follow product label instructions is not an accepted farm or forest practice. Every pesticide product label states explicitly, "It is a violation of Federal Law to use this product in a manner inconsistent with its labeling." The "violation" warning language is then followed by the admonition, "Do not apply this product in a way that will contact workers or other persons, either directly or through drift." Product labels often explicitly list practices that minimize or avoid drift. If a pesticide user were following these suggested practices, then they could be assured they are applying the product in a way that avoids contact with workers or other persons. The suggested drift avoidance practices are not considered "must do" mandates but following them allows a pesticide user to be assured they used the best practices to avoid contacting persons through drift.

All mandates on product labels for all pesticides in this risk analysis are shown in Appendix A4, Tables A4-1 through A4-3. The labels were especially scrutinized for mandates creating prohibitions on applying pesticides within a certain area of a sensitive site. These "no-spray zones", also known as application exclusion zones (AEZ), mandate variable numbers of feet between the perimeter row of a sprayed crop and a water body wherein no pesticide applications for that product formulation are permitted. No AEZs analyzed apply to bystander areas. Table 4 shows the eight pesticide products analyzed that had specific mandates for AEZs.

Table 4. Product label mandates for an AEZ for ten pesticide active ingredients

Active Ingredient	Product Formulation	Label Mandate Specifying Application Exclusion Zones
Fluvalinate	Mavrik Aquaflow	"For soil or foliar applications, do not apply by ground within 25 feet of lakes, reservoirs, rivers, streams, marshes or natural ponds, estuaries and commercial fish farm ponds."
Bifenthrin	Talstar S	"Do not apply by ground equipment within 25 feet of lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds. When treating tall trees (>15 feet) from the ground with high pressure sprays or during any application with air assisted equipment (mist blower) do not apply within 150 feet of aquatic areas."
Chlorothalonil	Bravo Ultrex	"This product must not be applied within 150 feet for aerial applications, or 25 feet for ground applications of marine/estuarine water bodies, unless there is an untreated buffer area of that width between the area to be treated and the water body."
Fludioxonil	Medallion WDG	"Do not apply within 75 ft of bodies of water such as lakes, reservoirs, rivers, permanent streams, natural ponds, marshes or estuaries." "For all plantings within 150 ft of bodies of water as described above, spray crops from outside the planting away from the bodies of water." "Do not cultivate within 10 ft of aquatic areas as to allow a vegetative filter strip."
Flutolanil	Prostar 70WP	"To reduce the potential for drift, the application equipment must be set to apply medium to large droplets (i.e., ASAE Standard 572) with corresponding spray pressure." Under Use Precautions heading, "For use rates over 2.2 oz per 1,000 squre ft, do not apply PROSTAR 70WP Fungicide within 100 ft. of any estuary or marine habitat or within 100 feet of any ditches, drainage tiles, or other waterways that drain directly into (within 1/2 mile of) estuaries or marine habitats."
Oxyflurofen	GoalTender	"A 25 foot vegetative buffer strip must be maintained between all areas treated with this product and lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries and commercial fish farm ponds."
Permethrin	Perm-Up 3.2EC	"Construct and maintain a minimum 10-foot wide vegetative filter strip of grass or other permanent vegetation between the field edge and down gradient aquatic habitat (such as, but not limited to: lakes; reservoirs; rivers; permanent streams; marshes or natural ponds; estuaries; and commercial fish farm ponds). Only apply products containing permethrin onto fields where a maintained vegetative buffer strip of at least 10 feet exists between the field and down gradient aquatic habitat." "Do not apply within 25 feet of aquatic habitats (such as, but not limited to: lakes; reservoirs; rivers; permanent streams; marshes; natural ponds; estuaries; and commercial fish ponds)."
Aminopyralid	Milestone	"Do not aerially apply Milestone within 50 feet of a border downwind (in the direction of wind movement), or allow spray drift to come in contact with any broadleaf crop or other desirable broadleaf plants, including, but not limited to, alfalfa, cotton, dry beans, flowers, grapes, lettuce, potatoes, radishes, soybeans, sugar beets, sunflowers, tobacco, tomatoes or other broadleaf or vegetable crop, fruit trees, ornamental plants, or soil where sensitive crops are growing or will be planted."

Scrutiny of the product label mandated AEZs was necessary to ensure that pesticide users would not have to change their practices to accommodate the Filtration Facility. The size of the AEZs applicable to the accepted pest management practices on the surrounding lands ranged from 10 ft (e.g., permethrin) to 75 ft (e.g., fludioxonil). Any product label with an AEZ less than 100 feet will not force a change in accepted pest management practices because at least 100 feet will exist between a spraying operation and the open water basins. Some mandates involved aerial applications with much longer AEZs than given for ground sprayers, but accepted agricultural and forestry practices in the surrounding lands do not use aerial applications.

Only the product label for Talstar S (active ingredient bifenthrin) has a mandate for an AEZ of 100 feet or greater. The Talstar S label states, “Do not apply by ground equipment within 25 feet of lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds”. The label then mandates that when trees greater than 15 feet tall are treated with air blast sprayers, a 150 ft AEZ from “aquatic habitats” must be maintained. The context of the label makes clear that “aquatic areas” does not include the open water basins at the Filtration Facility and instead is directed at “lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds” where “fish and aquatic invertebrates” or other “aquatic organisms” would be located. The purpose for this restriction is that this “pesticide is extremely toxic to fish and aquatic invertebrates” and “[d]rift … may be hazardous to aquatic organisms in neighboring areas.” Because the open water basins at the Filtration Facility are not habitat for any “aquatic organisms,” the AEZ does not apply and will not create restrictions for accepted farm and forest practices within the surrounding lands of the Filtration Facility. Moreover, the AEZ that is greater than 100 feet is related only to forestry operations and farm operations when the product is used on “trees greater than 15 feet tall.” The closest lands dedicated to forest use are >2000 feet from the open water basins of the Filtration Facility, significantly further than the Talstar AEZ. The nursery operations less than 150 feet from the open water basins would generally not have “trees greater than 15 feet tall” because nursery stock is sold when the trees are much smaller, especially considering modern orchard practices are replanting with trees under 10 feet that are supported by a network of trellises.

Thus, in consideration of the distance from a pesticide spraying operation and the water basins, as well as the type of application equipment used, this analysis concludes that the AEZ mandates will not force a significant change in or significantly increase the cost of accepted farm and forest practices in the surrounding lands of the Filtration Facility.

3.2 Toxicological Parameters Used by EPA in Registration Decisions Concerning Risk from Drift Exposures to Humans and Water

Prioritization of chemicals was important because one of the philosophical principles guiding EPA’s risk assessment protocols is that preventing exposures to pesticide dosages based on the most sensitive toxicology endpoint (i.e., expressed as the POD associated with the lowest body dose) will also be protective of all other possible effects that occur at higher doses. Similarly, if a risk analysis is completed with chemicals that rank highest on a prioritization list, then potential exposures to all other chemicals lower in the list would be considered less risky for adverse effects. However, to ensure that all accepted pest management practices near the Filtration Facility could continue without concerns of a conflict with the Filtration Facility operations, all of the chemicals were subjected to a risk analysis that might reveal exposures exceeding EPA’s standards for reasonable certainty of no harm.

Among the EPA array of documents used to prepare a draft registration decision document, the agency typically publishes one focused on human health hazards. This document includes narrative detail of the adverse observations from the various toxicological tests as well as defines the NOAEL or POD. For determining potential risk of adverse effects from dermal exposures, FIFRA requires submittal of “short term” dermal toxicity tests. These tests are conducted by exposing rats and/or rabbits to a defined area on a shaven dorsal surface and covered with a patch for several hours per day for 21-28 days. Thus, the test organisms are exposed directly to pesticide on the skin, and afterward examined for dermatological effects like lesions or other morphological abnormalities. In addition, systemic toxicity is examined via histopathology and blood analysis. Dermal toxicity tests are most relevant for understanding the potential effects of exposures during occupational and residential activities, especially while workers or residential occupants are applying the pesticides. Additionally, EPA analyzes post application exposures to understand potential risks from exposure to pesticide residues on surfaces like foliage.

Although EPA would ideally use dermal exposure toxicity testing to determine LOCs for situations involving spray drift, the agency often uses longer term dietary exposure tests and then applies a DAF to reflect an exposure solely from pesticide residues on skin. For purposes of determining ESDs, EPA’s designated aPADs were sought out in the human health risk analyses for registration determination. For some pesticides, especially those used as herbicides or fungicides, EPA does not have in their database of required testing studies any evidence of short term or acute hazards from pesticide exposure and thus EPA did not designate an aPAD (Table 3). For these pesticides, an equivalent of the aPAD was estimated for this risk analysis by examining EPA’s most sensitive toxicity test and resulting NOAEL for occupational and non-occupational (i.e., residential use) exposures over the short term. By applying a safety factor of 100, known as the Margin of Exposure (MOE), to the designated NOAEL, an equivalent LOC to the aPAD was calculated and then used in this risk analysis.

EPA uses a combination of AgDrift modeling and a runoff model called PRZM (Pesticide Root Zone Model) to estimate potential exposure to pesticide residues in drinking water. Drinking water pesticide residues are aggregated with residues in food and non-occupational uses to characterize overall risk of an exposure exceeding a PAD from any route of exposure. Owing to the planned infrastructure of the Filtration Facility, open water in the basins will not be affected by surface runoff. For modeling of potential drift to a water body, EPA uses as the receiving body of water a standard 2.42 acre pond that is six feet deep. The agency analysis assumes that a pesticide residue lands on the surface of the water but then is quickly mixed into the total volume. The EPA standard for determining the risk of exceeding the aPAD in drinking water only is based on comparison of estimated residues either to an established maximum contaminant level (MCL), a Health Advisory (HA), or to a Human Health Benchmark for Pesticides (HHBP). The MCL is an enforceable standard under the Safe Drinking Water Act, whereas an HA is simply a guideline that serves to indicate whether contamination could be exceeding the standard of reasonable certainty of no harm. The HHBP is a guideline for quickly determining exceedance of the aPAD if drinking water was the sole source of exposure. Drinking water standards and guidelines are discussed in the Graham Report (Graham 2022).

Similarly to EPA’s assumption about pesticide residues depositing on a water surface and then quickly mixing with the bulk of water, pesticide residues in this risk analysis were modeled as if they mixed instantaneously in a cubic meter of water. The resulting pesticide concentration at a distance of 100 feet from a sprayed crop row was defined herein as the RC and used for determination of the effects of changes in basin water volume on concentration relative to the MCL, HAs, of HHBs as denoted in the Graham Report.

3.3 AgDrift Modeling Output for Determination of ESDs

AgDrift output expresses drift as decreasing percentages of the spray volume from 20 swaths. This percentage deposition was transformed into mass of pesticide that varied among the pesticides according to the product labels maximum permissible field application rate (FAR). Because the application rate is based on mass of pesticide applied per surface area, the mass of pesticide depositing at any downwind distance could be transformed into body dosage units based on the exposed skin surface area normalized by body weight. The deposited mass on exposed skin was further modified to a body dose by applying the dermal absorption factor (DAF), expressed as the proportional transfer of the pesticide active ingredient from the skin surface (the epidermal stratum corneum) into the dermis where the blood capillaries are located and can quickly distribute the pesticide throughout the whole body. Modifying surface dosage from depositing pesticide droplets by the DAF accounts for systemic toxicity, which does not occur unless a chemical moves into the circulatory system and is then distributed to the tissues. EPA's PADs are based on systemic toxicity and the agency often modifies oral exposure toxicity tests by percentage dermal absorption factors to predict physiological effects from skin exposures. Because typically used toxicity studies are carried out for multiple days of exposure, the body doses are expressed on a daily time step basis and thus are expressed as mg/kg/day. However, in reality, any spray drift event is short term with spray deposition occurring within seconds to minutes depending on the droplet sizes, wind speed, and distance from a spray swath.

The transformed drifted residues for this study were calculated in an EXCEL spreadsheet relative to the distance downwind of the spray swath, yielding drift-deposition data in terms of body dose that could be represented graphically for each pesticide and spray scenario. A line representing EPA's designated aPAD for the pesticide active ingredient was overlaid horizontally across the graph, and where it intersected the curve, a perpendicular line was dropped to the distance axis. The distance at which drift was equal to the aPAD was defined as the "equivalent safe distance" (ESD). Figures 7 and 8 illustrate the procedure for graphically determining the ESD for the insecticides carbaryl and fluvalinate, the two pesticides rated the highest according to the hazard ranking procedure (Figure 3).

ESDs were easily determined by examining the EXCEL spreadsheet calculations of the downwind distance from a sprayer swath where the aPAD overlapped the estimated body doses. ESDs for the pesticides analyzed were tabulated by use class (i.e., insecticide, herbicide, fungicide) and organized by hazard ranking in Tables 5-7.

The largest ESDs occurred under the high boom, fine to very fine spray scenario. The volume median diameter of droplets in the fine to very fine spray scenario favor horizontal movement of a greater proportion of the spray than spray quality defined as fine to medium coarse. Boom height influences drift potential with lower boom heights empirically reducing percentage of drift compared to higher boom heights (Nuttyens et al. 2006; Balsari et al 2015; Fredericks and Alonzi 2021).

ESDs for all pesticides ranged from 0 feet to 85 feet downwind from a spray swath. The zero feet results mean that, according to EPA human health protection mandates under FIFRA, a reasonable certainty of no harm would occur to a person incidentally exposed to pesticide drift adjacent to the spray swath. Because all ESDs were less than the distance separating farm and forest spray applications and the bystander area of the Filtration Facility, any bystanders at the Filtration Facility would have nil risk of exposure above EPA's levels of concern. Therefore, use of any pesticide on the adjacent farm and forest land will not cause a significant change in or significantly increase the cost of farm or forest practices in the surrounding lands.

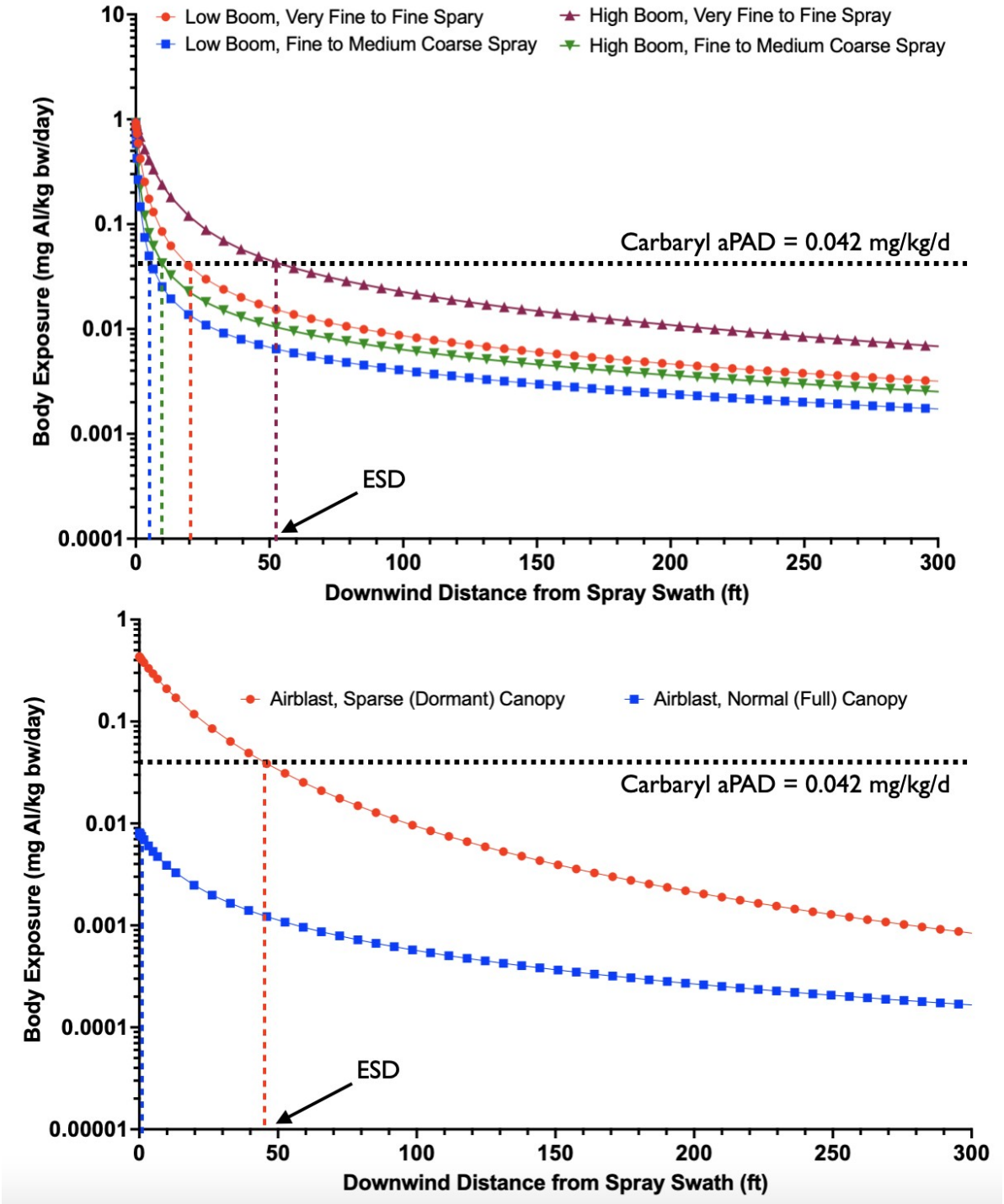

Figure 7. Drift deposition curve for carbaryl expressed as a body exposure (milligrams active ingredient per kilogram body weight per day, mg AI/kg bw/day or mg/kg/d). The horizontal dashed black line represents the EPA defined aPAD. The vertical dashed lines represent the ESD expressed as feet from the last sprayed swath from an application using a ground boom sprayer or an airblast sprayer.

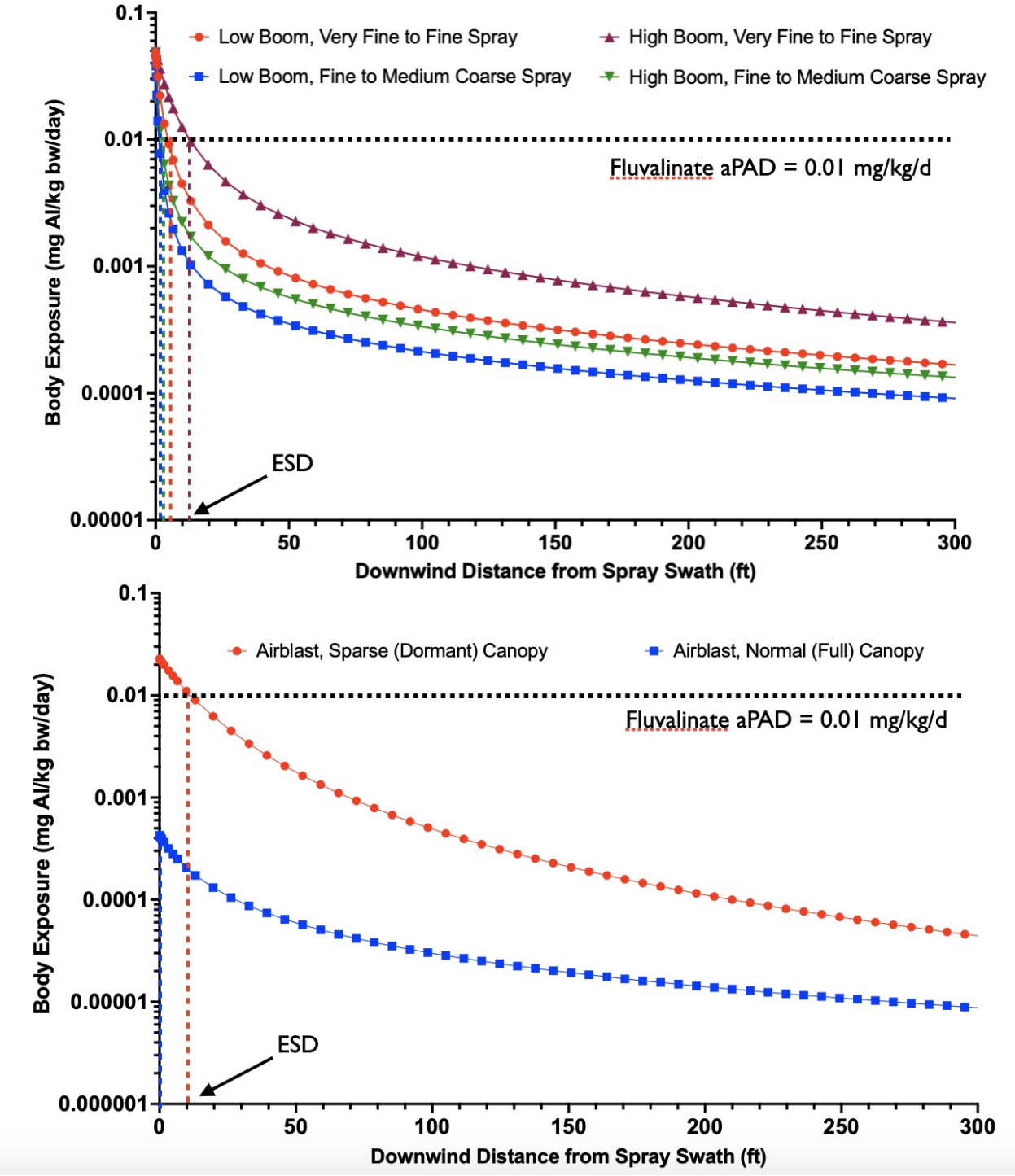

Figure 8. Drift deposition curve for fluvalinate expressed as a body exposure (milligrams active ingredient per kilogram body weight per day, mg/kg/d). The horizontal dashed black line represents the EPA defined aPAD. The vertical dashed lines represent the ESD expressed as feet from the last sprayed swath from an application using a ground boom sprayer or an airblast sprayer.

Table 5. Insecticide equivalent safe distances (ESD) estimated from AgDrift modeling for six application scenarios; ESDs were adjusted by EPA-defined dermal absorption factors. Insecticides are listed in order of descending hazard ranking.

	Application Scenario ESDs (ft)					
Pesticide AI	Low Boom, Fine	Low Boom, Medium Coarse	High Boom, Fine	High Boom, Medium Coarse	Airblast, Sparse	Airblast, Normal
Carbaryl	20	7	53	10	46	0
Fluvalinate	5	2	13	3	13	0
Spinosad	0	0	0	0	0	0
Bifenthrin	0	0	0	0	0	0
Imidacloprid	1	0	2	0	0	0
Cyfluthrin	0	0	0	0	0	0
Permethrin	0	0	0	0	0	0

Table 6. Herbicide equivalent safe distances (ESDs) estimated from AgDrift modeling for four application scenarios; ESDs were adjusted by EPA-defined dermal absorption factors. Herbicides are listed in order of descending hazard ranking.

	Application Scenario ESDs (ft)			
Pesticide AI	Low Boom, Fine	Low Boom, Medium Coarse	High Boom, Fine	High Boom, Medium Coarse
Glufosinate	10	3	20	3
Paraquat	3	1	0	0
Oryzalin	0	0	0	0
Flumioxazin	3	2	10	2
Prodiamine	0	0	1	0
Dithiopyr	33	10	85	20
Triclopyr BEE	0	0	0	0
Trifluralin	0	0	0	0
Glyphosate	13	5	39	7
Hexazinone	13	3	33	7
Oxyfluorfen	0	0	0	0
Clopyralid	3	1	7	1
Indaziflam	0	0	0	0
Isoxaben	0	0	0	0
Clethodim	0	0	0	0
Aminopyralid	0	0	0	0

Table 7. Fungicide equivalent safe distances (ESD) estimated from AgDrift modeling for six application scenarios; ESDs were adjusted by EPA-defined dermal absorption factors. Fungicides are listed in order of descending hazard ranking.

	Application Scenario ESDs (ft)					
Pesticide AI	Low Boom, Fine	Low Boom, Medium Coarse	High Boom, Fine	High Boom, Medium Coarse	Airblast, Sparse	Airblast, Normal
Flutolanil	20	7	52	10	43	0
Chlorothalonil	0	0	2	0	0	0
Metconazole	1	0	2	0	0	0
Fludioxonil	5	2	13	3	13	0
Propiconazole	0	0	0	0	0	0
Myclobutanil	0	0	0	0	0	0
Azoxystrobin	0	0	0	0	0	0

3.4 AgDrift Modeling Output for Determination of Extent of Drift to Water Basins

Potential deposition of pesticides into the Filtration Facility open water basins was calculated by assuming that any drifting residues landed on the surface of the water and instantaneously mixed into the full depth modeled. Modeled water residues decreased exponentially over downwind distances up to 1000 feet, similarly to a decreasing estimated exposure to a bystander at increasing distances from a spray swath. The resulting residue concentrations in a 10-foot of water depth at a distance of 100 feet from a spraying operation (i.e., the RC) were compared to EPA established enforceable standards (MCLs) or non-enforceable guidelines (HAs or HHBPs) in the Graham Report (Graham 2022). Even without taking into consideration the actual dilution addressed in the Graham Report, at a distance of 100 feet from a sprayed perimeter crop row, estimated concentrations in a 10-foot deep water body were well below the levels for any water quality standard or guidelines protective of human health.

AgDrift has a flowing water computational module that estimates residue concentrations occurring from drift at various distances from a flowing stream. Modeling residues in flowing water shows an initial spike that is diluted to near background levels within minutes after deposition at any specific point (Teske 2000; Felsot 2003). For computation of the RC, however, the most conservative case was modeled by assuming no dilution and assuming the sprayer scenario of high boom, very fine to fine spray quality. The effect of routine Filtration Facility operations on the dynamics of water levels in the open basins was modeled in the ancillary report by Graham (2022).

4. Discussion

4.1 EPA Derived Benchmark Parameters Comply with FIFRA-Mandated Standards and Are Appropriate for Determination of Health Risks from Drift

The objective of EPA's hazard assessment is to determine the most sensitive toxicology endpoint from the expansive array of studies required for determination of a registration decision. All studies are conducted under FIFRA-mandated Good Laboratory Practices to ensure integrity of data collection according to pre-established protocols, and all procedures and reports are subjected to independent quality assurance auditing (FIFRA 1997). Agency scientists use the raw unmanipulated data submitted by industry to undertake their own independent risk analysis following the assessment methodology sanctioned by the National Academy of Sciences. Thus, the agency-determined most sensitive toxicological endpoints are turned into LOCs that are represented by PADs for either acute or chronic exposures. The hazard characterization part of a risk assessment along with both modeled and measured pesticide exposures are aimed at ensuring that any exposure by any route (dietary, drinking water, occupational, and non-occupational uses) meet the mandated standard of safety under the Food Quality Protection Act, which is interpreted as a reasonable certainty of no harm (EPA 2022b).

Pertinently, for older compounds on the market, EPA will investigate the primary research literature of toxicological studies by academic and research institutions to determine if their benchmarks would be more protective of human health than the agency determined PADs. Occasionally, EPA will request further data from pesticide registrants that focuses on particular physiological effects. Thus, EPA derived benchmarks for safety are the most appropriate ones for determining whether accepted farm and forest practices compliant with pesticide product label mandates might be negatively affected by the Filtration Facility. Furthermore, EPA derived safety benchmarks are also appropriate for concluding that the finished water from the Filtration Facility will meet all standards and guidelines for safety regardless of ongoing farm and forest practices in the surrounding lands.[1]

4.2 Risk Analysis Results Show that Accepted Farm and Forest Pest Management Practices Will Not Be Adversely Affected by the Filtration Facility

The problem formulation section of this report proposed that any potential conflict between the Filtration Facility and pest management practices on surrounding lands could be attributed to drift that might expose bystanders or result in contamination of water. The only feasible pathway for human or water exposure would be by pesticide drifting off-target from sprayed farm or forest lands. Thus, the risk analysis proceeded by using AgDrift, a predictive model for simulating drift long used by EPA to estimate exposures to humans and any other terrestrial or aquatic organisms. The same model was used to estimate potential drift of pesticide residues into the open water basins by focusing predictions of water deposition at 100 ft from a sprayed perimeter crop row to the open water basins. Thus, methods used in this risk assessment are similar to what the EPA would use and are therefore appropriate for determining whether the Filtration Facility would have adverse impacts on accepted pest management practices in the surrounding lands.

[1] The Oregon Water Quality Criteria rules were also examined to ensure no State guidelines would be violated from drifting residues, but no pesticides analyzed in this risk analysis were covered in those regulations.

The concept of an equivalent safe distance (ESD) was developed to determine at what distance from a sprayed crop row drift to bystanders would violate EPA's assessment for safe exposures, i.e., exposures that conform to the legal mandate of "reasonable certainty of no harm." EPA derived LOCs that represent acute or short-term exposures were most appropriate for determining the ESDs, as was using dermal absorption factors (DAFs) that allowed translating toxicological studies by oral exposure to dermal exposures. AgDrift was programed with different sprayer operational scenarios, including those with the most conservative assumptions for drift potential, i.e., the ground sprayer operated with a high boom and nozzle type yielding very fine to fine spray droplet sizes. The inherently conservative nature of AgDrift for overestimating drift deposition downwind from a spray swath also ensured any exposures are not unintentionally underestimated.

Despite all the conservatism built into the risk assessment techniques and assumptions, the resulting ESDs for the 30 pesticides were all 50 feet or less relative to a sprayer swath, with the exception of the herbicide dithiopyr at 85 feet. Therefore, because Filtration Facility bystander areas (inside the perimeter fence) are at least 100 feet from the closest possible spraying operations, none of the analyzed pesticides would drift sufficiently to result in potential pesticide exposures exceeding EPA's levels of concerns for human health. Therefore, farm and forest pest management practices would not have to be altered in any way to remain in compliance with the label mandates about avoiding drift directly onto workers or other persons.

Potential for drifting pesticide residues to reach open water basins was analyzed using the most conservative assumptions as possible for the analysis to ensure that neither Safe Drinking Water enforceable standards nor unenforceable guidelines would be violated. The Oregon Water Quality Criteria rules were also examined to ensure no State guidelines would be violated from drifting residues but no pesticides analyzed in this risk analysis were covered in those regulations. Without considering that any drifting pesticide residue that landed on the surface of the water basins would be diluted by the volume and inflow and outflow of water, none of the pesticides exceeded any drinking water quality standards or guidelines within 100 feet of a spraying operation (discussed in Graham 2022). Therefore, from the perspective of protecting drinking water quality, the Filtration Facility would not affect pest management practices in the surrounding lands.

This risk analysis to develop ESDs and predict possible pesticide residues in water was based on current pesticide use practices according to user surveys and associated pesticide product label mandates defining accepted farm and forest practices. Future use of newly developed and registered pesticides may be beneficial for adjacent agricultural operations. Furthermore, the closest forestry operations within two miles of the Filtration Facility may request a NOAP for a pesticide application. Future developments regarding pesticide use can be assessed for potential impacts on agricultural and forest pest management operations through the hazard ranking procedure reported in Section 2.3. The widely diverse array of pesticides currently used are representative of the most hazardous pesticides that EPA has registered as well as the least hazardous. Because the hazard ranking is actually a ratio between PADs and application rates, and the array of pesticides in this report represented older compounds that are used at rates of pounds per acre as opposed to the trend for modern pesticide rates being ounces per acre, any new pesticide on the market is more likely than not covered by this risk analysis of ESDs and water concentrations due to drift.

The overall conclusion of this risk characterization is twofold. First, the proposed Filtration Facility will not force a significant change in, nor significantly increase the cost of, accepted farm or forest practices in the surrounding lands of the Filtration Facility site. Second, with setbacks from property lines as part of the design, the location of the Filtration Facility at a site near pesticide users will not create a risk of pesticide residue concentrations in the finished water that

exceed safe drinking water quality standards or guidelines. Fundamentally, these conclusions are based on the risk analyses presented herein showing that the distances between any pesticide use in the surrounding lands and the bystander and open water areas of the Filtration Facility are sufficiently wide to exceed the distances needed to ensure compliance with label mandates, to exceed ESDs modeled by AgDrift for all chemicals, and to exceed distances modeled to ensure any drift deposited on open water basins results in finished water concentrations significantly lower than clean drinking water standards and guidelines.

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6. Appendices

Appendix A1. List of Agricultural Chemicals Used in Farm and Forest Practices in the Surrounding Lands of the Filtration Facility

Insecticides

Table A1-1 Arthropod (Insect) control for ornamental plants grown in greenhouses

Insect or Mite	Pesticide Common Name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted Application Sites: can differ by trade name; see label
Aphid	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
	imidacloprid (Marathon II)	12 hr	4A	G, N
Broad Mite	abamectin (Avid)	12 hr	6	G, L, N
	bifenthrin (Talstar)	12 hr	3A	G, L, N
Caterpillar	abamectin (Avid)	12 hr	6	G, L, N
	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
Fungus Gnat	acetamiprid (TriStar)	12 hr	4A	G, L, N
	bifenthrin (Talstar)	12 hr	3	Follow label
	diflubenzuron (Adept)	12 hr	15	G
	imidacloprid (Marathon)	12 hr	4A	G, N
Leafminer	acephate (Orthene)	24 hr	1B	G, L, N
	acetamiprid (TriStar)	12 hr	4A	G, L, N
	dinotefuran (Safari)	12 hr	4A	G, L, N
Scale (Armored)	fenoxycarb (Preclude)	12 hr	78	G
Spider Mites	bifenazate (Fioramite)	12 hr	20D	G, L, N

Insect or Mite	Pesticide Common Name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted Application Sites: can differ by trade name; see label
	clofentezine (Ovation)	12 hr	10A	G, N
	etoxazole (TetraSan)	12 hr	10B	G, L, N
Thrips	cyfluthrin (Decathlon)	12 hr	3A	G, L, N
Whitefly	pyridaben (Sanmite}	12 hr	21A	G, L, N
	thiamethoxam (Flagship)	12 hr	4A	G, N

IRAC Mode of Action Group is a classification system by the Insecticide Resistance Action Committee that guides growers, advisors, extension staff, consultants, and crop protection professionals to the select acaricides or insecticides for use in an effective and sustainable management (IRM) strategy. See at www.irac-online.org.

Trade names are common examples of products that contain the active ingredient and not an endorsement of a particular product.

Permitted application sites: G = greenhouse, L = landscape, and N = nursery.

Table A1-2 Arthropod (insect) control for ornamental plants field-grown in nurseries

Insect or Mite	Pesticide Common Name (Example trade name)	Minimum Hours Between Application and Reentry	IRAC Mode of Action Group	Permitted Application Sites: can differ by trade name; see label
Aphid	fluvalinate (Mavrik)	12 hr	3	G,L
Ambrosia Beetle	permethrin (Astro, Perm-up, Permethrin Pro)	12 hr	3	Follow label
Lepidoptera caterpillars	bifenthrin (Onyx, Talstar)	Follow label	3	Follow label
	cyfluthrin (Decathlon)	12 hr	3A	G. L. N
Leafhoppers	carbaryl (Sevin)	12 hr	1A	L. N
Sawfly	cyfluthrin (Decathlon) 20WP	Follow label directions	3	G,N
	spinosad (Conserve SC)	4hr	5	G,N
	imidacloprid (Marathon)			

IRAC Mode of Action Group is a classification system by the Insecticide Resistance Action Committee (IRAC) that guides growers, advisors, extension staff, consultants, and crop protection professionals to the select acaricides or insecticides for use in an effective and sustainable insecticide resistance management (IRM) strategy. See at irac-online.org.

Trade names are common examples of products that contain the active ingredient and not an endorsement of a particular product.

Permitted application sites: G = greenhouse, L = landscape, and N = Nursery.

Herbicides

Table A1-3 Weed control in field-grown nursery stock

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Approximate Frequency of Use	Chemical Family
Preplant Incorporated and Preemergence				
dithiopyr (Dimension)	Apply to bare ground before weeds germinate	3	More frequent use	Pyridine
flumioxazin (SureGuard, and other trade names)	Apply before or after weeds emerge. Kills existing annual weeds if weeds are less than 2 inches.	14	More frequent use	N-phenylphthalimide
flumioxazin (BroadStar 0.25G)	Apply to weed-free surface. *Foliage of desirable crops must be dry at the time of application. Wet foliage will trap granules on leaf surface and burn foliage.*	14	More frequent use	N-phenylphthalimide
flumioxazin +prodiamine (Fuerte)	Apply before or after weeds emerge. Kills existing annual weeds if weeds are less than 2 inches in diameter. *Foliage of desirable crops must be dry at the time of application. Wet foliage will trap granules on leaf surface and burn foliage.*	14 + 3	More frequent use	(flumloxazin) N-phenylphthalimid; (prodiamine) (Pyridine
indaziflam (Marengo G)	*Marengo G may be applied as a single or in sequential applications over-the-top to container-grown, deciduous, and evergreen trees and shrubs with an established root system. Do not apply to trees that are less than one year old or have been transplanted less than one year, unless completely protected by non-porous wraps, grow tubes, waxed protectors or other forms of protection to young foliage and/or bark. Applications of Marengo G should only be made to ornamentals listed on the label. Do not use Marengo G on ornamentals being grown in a greenhouse, on nursery seedbeds, or on rooted cuttings or young plants in liners. Do not apply Marengo G to plants growing in containers less than 6*	29	More frequent use	Alkylazine

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Approximate Frequency of Use	Chemical Family
	inches wide.			
isoxaben (Gallery 75DF	Apply in late summer to early fall, in early spring, or immediately after cultivation. Apply to debris-free soil surface. *Do not apply to newly transplanted crops until media settle.*	21	Less frequent use	Benzamide
isoxaben + trifluralin (Snapshot 2.5 G)	Apply to soil that is free from weeds and debris. *Do not apply to unrooted liners or cuttings, bedding plants, or new-planted ground cover.*	21 + 3	Less frequent use	(isoxaben) benzamide; (trifluralin) dinitroaniline
oryzalin (Surflan AS)	Apply any time to bare soil. Activate within 21 days with 0.5 inch water. Wait at least 90 days before repeating application. Apply only to established plantings.	3	Less frequent use	Dinitroaniline
prodiamine (Barricade 4F)	Apply to weed-free site. *Do not exceed maximum rate on label in a 12-month period. Do not apply to recently planted red maple (Acer rubrum) liners; this species is not labeled, and severe girdling has been observed in several Oregon nurseries.*	3	Less frequent use	Dinitroaniline
Preemergence and Postemergence				
oxyfluorfen (Goaltender)	Apply to deciduous, field-grown shade trees listed on label; direct the applications toward the soil and tree base. Apply to 2-0 conifers in winter dormancy fall through winter. After transplanting, irrigate with 0.5 to 0.75 inch of water or rain for preemergence control of annual grass and broadleaf weeds. *Do not exceed 2 lb ai/a per year.*	14	Less frequent use	Diphenylether
Postemergence				
clethodim (Envoy Plus)	Apply postemergence to actively growing annual or perennial grasses as listed on label. 9 to 16 oz/a for annual grass control; 12 to 32 oz /a for perennial grass control. *Do not exceed 64 fl oz/a per season.*	1	Less frequent use	Cyclohexanedione

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Approximate Frequency of Use	Chemical Family
glyphosate (numerous products)	Apply as a directed spray toward the base of a tree when weeds are actively growing or moving sugars to roots. *Do not spray green bark, foliage, or root suckers. If repeat applications are necessary, do not exceed a total of 10.6 lb ai/a (10.6 quarts/a) per year.*	9	More frequent use	None generally accepted
glyphosate (several products)	Mix 1 gal product to 2 gal water and wipe weeds, avoiding contact with desirable vegetation.	9	More frequent use	None generally accepted
paraquat (Gramoxone SL 2.0)	Apply as a directed or directed-shielded application when weeds are small (6 inches or less) and actively growing. *A restricted-use herbicide. Do not ingest or inhale spray mist. Wear protective face shields, respirators, and clothing.*	22	More frequent use	Bipyridilium

The Weed Science Society of America (WSSA) Herbicide Site of Action (SOA) classification identifies the specific process in plants that the herbicide disrupts to interfere with plant growth and development. The SOA is the most important aspect of herbicides when dealing with prevention and control of herbicide-resistant weeds. See at wssa.net.

Frequency of use is a general guide to usage and stated by the farmer interviewed. More frequent use is several times per year; less frequent use would be generally once per year or less.

Trade names are common examples of products that contain the active ingredient and not an endorsement of a particular product.

Table A1-3 Weed control in container-grown nursery stock

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Frequency of Use	Chemical Family
Preemergence Weed Control within Containers				
Dimethenamid-P (Tower)	Apply only to dry crop foliage, either before weed seeds germinate or after completely removing weeds. *Allow soil or planting mixes to settle firmly around transplants after the transplants have been watered and the soil has been packed, Making sure that there are no cracks in the soil that would allow Tower to contact roots directly. Do not apply to unrooted liners or plugs. Do not apply during bud swell, bud break, or at time of first flush of new growth.*	15	More frequent Use	chloroacetamide
dithlopyr (Dimension)	Apply to bare ground, or containers before target weeds germinate.	3	Less frequent use	Pyridine
flumloxazin (SureGuard)	Apply to weed-free containers or containers with small weeds (less than 2 inches tall). Apply to established and dormant conifers before bud break or after they have hardened off (see label for list of approved species). *Do not apply over the top of deciduous or broadleaf evergreen crops.*	14	More frequent use	N-phenylphthalimide
flumloxazin (BroadStar 0.25G)	Apply to weed-free containers.	14	Less frequent use	N-phenylphthalimide
flumloxazin +prodiamine (Fuerte)	Apply before or after weeds emerge. Kills existing annual weeds if weeds are less than 2 inches. *Foliage of desirable crops must be dry at the time of application. Wet foliage will trap granules on the leaf surface and burn foliage.*	14 + 3	More frequent use	(flumloxazin) N-phenylphthalimide; (prodiamine) Pyridine

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Frequency of Use	Chemical Family
indazifam (Marengo G)	Marengo G may be applied as a single or in sequential applications over-the-top to container-grown, deciduous, and evergreen trees and shrubs with an established root system. *Do not apply to pots less than 6 inches wide. Application of Marengo G to deciduous foliage or green bark may result in unacceptable injury. Applications made to wet foliage may cause the product to stick to the foliage and lead to localized injury.*	29	More frequent use	Alkylazine
isoxaben (Gallery 75 DF)	Apply to weed-free soil in containers. *Do not apply to newly transplanted crops until medium is settled (two to three irrigations).*	21	Less frequent use	Benzamide
isoxaben + trifluralin (Snapshot 2.5 G)	Apply to weed-free soil. *Do not apply to unrooted liners or cuttings, bedding plants, or new-planted ground cover.*	21	Less frequent use	(isoxaben) benzamide; (trifluralin) dinitroaniline
oryzalin (Surflan AS)	Apply to established plants only in weed-free containers and irrigate as soon as possible with 0.5 inch of water. *Do not apply again within 90 days.*	3	Less frequent use	Dinitroaniline
oxyfluorfen (Goal 2XL)	Apply after transplanting to dormant conifer stock. Irrigate with 0.5 to 0.75 inch of water for preemergence control of annual grasses and broadleaf weeds. *For conifers and selected deciduous trees only.*	14	More frequent use	Diphenylether
oxyfluorfen + oxadiazon (Regal O-O Herbicide)	Apply uniformly before weeds begin to germinate and emerge; follow with 0.5 inch of water irrigation to activate the herbicide.	14	More frequent use	(oxyfluorfen) diphenylether; (oxadiazon) oxadiazole
oxyfluorfen + prodiamine (Blathlon)	Apply Biathlon prior to weed seed germination. For application in the fall, apply two weeks prior to placing plants in an empty, enclosed greenhouse structure. *Do not apply to wet foliage.*	14	More frequent use	(oxyfluorfen) Diphenylether + (prodiamine) Dinitroaniline
Postemergence Weed Control within Containers				

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Frequency of Use	Chemical Family
clethodim (Envoy Plus)	For selective postemergence grass control. Apply postemergence to actively growing annual or perennial grasses as listed on the label. Consider environmental and plant growth conditions that affect leaf uptake; see label for guidelines. Do not exceed 68 fl oz/a per season.	1	More frequent use	Cyclohexanedione
Container Growing Areas				
dichlobenil (Casoron 4G)	Treat area before containers are set in midwinter when temperatures are cold and rain is expected immediately after application to activate herbicide and prevent loss by volatility.	20	Less frequent use	Nitrile
glufosinate ammonium (Finale)	Apply around containers to thoroughly cover actively growing weeds.	10	More frequent use	Phosphinic acid
oryzalin (Surflan)	Apply any time to a weed-free area beneath and around container-grown stock listed on label.	3	More frequent use	Dinitroaniline
pelargonic acid (Scythe)	Apply to thoroughly wet weed foliage as a directed spray around containers. Most effective when temperature is above 65°F.	26	More frequent use	Carboxylic acid

Table A1-4 Weed control in greenhouse, shadehouse, or lathhouse floors

Herbicide Common Name (Example trade name)	Timing	WSSA Site of Action Group	Approximate Frequency of Use	Chemical Family
clethodim (Envoy Plus)	Apply postemergence to actively growing annual or perennial grasses as listed on label. *Do not exceed 68 fl oz/a per season.*	1	More frequent use	Cyclohexanedione
glyphosate (several products)	Apply to actively growing weeds when desired vegetation is out of greenhouse and air circulation fans are turned off.	9	More frequent use	None generally accepted
indazifam (Marenfo G)	Make applications to these sites during clean up, sanitation, and preparation prior to plant production. *Do not apply Marengo G to areas where water can potentially move Marengo G off the application area.*	29	More frequent use	Alkylazine
oryzalin (Surflan AS)	Apply Prior to weed emergence. *Use in open greenhouse-type structures only.*	3	More frequent use	Dinitroaniline
pelargonic acid (Scythe)	Apply to thoroughly wet weed foliage in and around greenhouse, under benches, or preemergence in seedling beds.	26	Less frequent use	Carboxylic acid

Fungicides Used by Nurseries; Trade Name (active ingredient)

- Eagle (myclobutnil)
- Tourney (metconazole)
- Prostar (flutolanil)
- Heritage (azoxystrobin) Messenger (harpin)
- Medallion (fludioxonil)

Other fungicides:

- Propiconazole
- Chlorothalonil

Fumigants Used by Nurseries (Two fumigants were identified by growers):

- Methyl bromide
- Pic-Clor 60 (Chloropicrin)

Rodenticides (Pocket Gophers and Voles)

- Zinc phosphide (below ground treatment only)

Herbicides Commonly Used in Forestry Operations

- Active ingredient (Most Commonly Used Product Formulations)
- Glyphosate (Roundup, Rodeo, Accord, Alligare)
- Triclopyr BEE (Garlon, Crossbow, Vastlan)
- Clopyralid (Transline, Stringer)
- Hexazinone (Velpar)

Appendix A2. Product label signal words are determined from five different acute toxicity tests.

The basis for assigning signal words to pesticide product labels are the acute toxicity parameter known as the LD50, the median lethal concentration by either oral, dermal, or inhalational exposure routes (EPA 2003). Each toxicity category is based on a range of LD50s that differ by exposure route. Category 1 pesticide labels must have the word Danger (and if the pesticide in this category is also neurotoxic, as many insecticides are, the signal word used Danger-Poison with an adjacent skull and crossbones symbol). Category II pesticide labels display the signal word Warning. The signal word Caution is associated with pesticides falling into Category III and IV.

Table 1 - Toxicity Categories

Study	Category I	Category II	Category III	Category IV
Acute Oral	Up to and including 50 mg/kg	> 50 thru 500 mg/kg	> 500 thru 5000 mg/kg	> 5000 mg/kg
Acute Dermal	Up to and including 200 mg/kg	> 200 thru 2000 mg/kg	> 2000 thru 5000 mg/kg	> 5000 mg/kg
Acute Inhalation[1]	Up to and including 0.05 mg/liter	> 0.05 thru 0.5 mg/liter	> 0.5 thru 2 mg/liter	> 2 mg/liter
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or other eye irritation clearing in 8-21 days	Corneal involvement or other eye irritation clearing in 7 days or less	Minimal effects clearing in less than 24 hours
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hours (moderate erythema)	Mild or slight irritation at 72 hours (no irritation or slight erythema)

[1] 4 hr exposure

Reference: EPA (2003) Label Review Manual. Chapter 7, Precautional Statements, p 7-2.

Appendix A3. Hazard Rankings of Pesticides

Table A3-1. Hazard ranking of pesticides used in the surrounding lands of the proposed Filtration Facility based on acute toxicity benchmarks protecting human health integrated with the approved maximum application rate of the active ingredient product formulation. [1/]

Pesticide AI	Acute RfD/PAD (aPAD) (mg/ kg/d)	Product Formulat-ion	Maximum Applicat-ion Rate (lbs/A)	Maximum Applicat-ion Rate (mg/m^2)	mg per Body Surface Area (mg/ m2) [2/]	Hazard Rank-ing[3/]
Carbaryl	0.049	Sevin	2	224	0.91574	244.6
Fluvalinate	0.01	Mavrik Aquaflow	0.34	38.2	0.18689	204.4
Glufosinate	0.063	Finale	1.5	168.128	1.17738	142.8
Paraquat	0.05	Gramoxone SL2.0	1.0	112.2	0.93443	120.1
Flutolanil	NE	Prostar	8.57625	961.5	9.34426	102.9
Spinosad	0.042	Conserve SC	0.6872	77.1	0.78492	98.2
Oryzalin	0.25	Surflan AS	4	448.25	4.67213	95.9
Flumioxazin	0.03	SureGuard	0.38	42.592	0.56066	76.0
Prodiamine	0.14	Barricade 4FL	1.5	168.13	2.61639	64.3
Dithiopyr	0.05	Dimension	0.5	56.0425	0.93443	60.0
Triclopyr BEE	1.0	Garlon 4	8	896.74	18.68852	48.0
Bifenthrin	0.031	Talstar S	0.2	22.44	0.57934	38.7
Imidacloprid	0.08	Marathon II	0.408	45.7728	1.49508	30.6
Trifluralin	1.0	Snapshot 2.5TG	4	448.25	18.68852	24.0
Glyphosate	1.0	Roundup Pro	3.75	420.32	18.68852	22.5
Hexazinone	1.25	Velpar VU	4	448.25	23.36066	19.2
Chlorothalonil	1.0	Bravo Ultrex	3.1	347.430	18.68852	18.6
Metconazole	0.12	Tourney	0.27225	30.55	2.24262	13.6
Cyfluthrin	0.0117	Decathlon 20WP	0.112	2.669	0.21866	12.2
Fludioxonil	0.5	Medallion	0.68	76.218	9.34426	8.2
Oxyflurofen	1.8	GoalTender	2	224.17	33.63934	6.7
Permethrin	0.44	Perm-Up 3.2EC	0.4	44.835	8.22295	5.5
Propiconazol	0.3	Tilt	0.22	24.659	5.60656	4.4

Pesticide AI	Acute RfD/PAD (aPAD) (mg/ kg/d)	Product Formulat-ion	Maximum Applicat-ion Rate (lbs/A)	Maximum Applicat-ion Rate (mg/m^2)	mg per Body Surface Area (mg/ m2) [2/]	Hazard Rank-ing[3/]
e						
Clopyralid	0.75	Transline	0.500	56.04	14.01639	4.0
Isoxaben	2.0	Gallery 75DF	0.995	111.81	37.37705	3.0
Myclobutanil	0.6	Eagle 20EW	0.25	28.021	11.21311	2.5
Azoxystrobin	0.67	Heritage	0.25	28.02	12.52131	2.2
Clethodim	1.0	Envoy Plus	0.2425	27.18	18.68852	1.5
Aminopyralid	1.04	Milestone	0.109375	12.26	19.43607	0.6
Indaziflam	0.50	Marengo G	0.0448	5.021	9.34426	0.5

1/ Maximum application rates have been rounded to one (mg/m2) or two (lbs/acre) significant figures after the decimal. The mg per body surface area has been rounded to three significant figures, and the Hazard Ranking has been rounded to one significant figure.

2/ mg per body surface area = (aPAD x bw)/surface area; bw (body weight) for 2-year old = 11.4 kg; whole body surface area for 2-year old = 0.61 m2

3/ Hazard Rating (HR) = [maximum application rate] / [(PAD x bw)/body surface area]

4/ For the pesticides dithiopyr, spinosad, isoxaben, prodiamine, glyphosate, clopyrialid, fludioxonil, and aminopyralid, EPA did not establish a specific acute PAD based on short term or single dietary exposure. EPA concluded that the toxicology data showed no acute term dietary or dermal exposure risk. However, using a different toxicology study than that used for the cPAD, the agency did consider an alternative short-term NOAEL that was applied to both residential use and worker use risk assessment. For these pesticides, the aPAD shown is based on EPA's assessment for short term (defined as up to 30 days) exposure and the delineated NOAEL with a 100-fold safety factor (MOE) applied.

5/ NE = Not Established; acute exposure risk of adverse effects not of concern to EPA for any route of exposure whether to dietary exposure or residential/worker use exposure, and thus the agency did not propose an LOC for short term exposures. The agency only proposed a cPAD that was applicable specifically to long-term (defined as "lifetime") dietary exposure.

Appendix A4: Insecticide Formulations and Product Use Mandates Regarding Spraying Operations

Table A4-1. Insecticide active ingredients and information on product labels regarding use restrictions

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
Bifenthrin	Talstar S	279-3155	Caution	Yes	12
Carbaryl	Sevin SL	432-1227	Caution	No	12
Cyfluthrin	Decathlon 20WP	59807-17	Caution	No	12
Fluvalinate	Mavrik Aquaflow	2724-478	Caution	No	12
Imidacloprid	Marathon II	53883-232-59807	Caution	No	12
Permethrin	Perm-Up 3.2EC	70506-9	Caution	Yes	12
Spinosad	Conserve SC	62719-219	Caution	No	4
	Label Mandates				
Bifenthrin	"Do not apply when a temperature inversion exists"; "Do not apply by ground equipment within 25 feet of lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds. When treating tall trees (>15 feet) from the ground with high pressure sprays or during any application with air assisted equipment (mist blower) do not apply within 150 feet of aquatic areas."				
Carbaryl	"Adjust deflectors and aiming devices so that spray is only directed into the canopy; Block off upward pointed nozzles when there is no overhanging canopy; Do not allow the spray to go beyond the edge of the cultivated area (i.e., turn off sprayer when turning at end rows); For applications to the outside rows, only spray inward, toward the orchard." (Applies to airblast sprayer use)				
Cyfluthrin	"Do not apply Decathlon 20 WP or allow it to drift onto crops or weeds on which bees are foraging."				
Fluvalinate	"Not for broadcast use in nurseries." "Spot treatments must not exceed two square feet in size (for example, 2' x 1' or 4' x 0.5')." "For soil or foliar applications, do not apply by ground within 25 feet of lakes, reservoirs, rivers, streams, marshes or natural ponds, estuaries and commercial fish farm ponds." "Applicators are required to select the nozzle and pressure that deliver a medium or coarser droplet size (ASABE F572)."				
Imidacloprid	"Do not apply Marathon II while bees are foraging. Do not apply Marathon II to plants that are flowering. Only apply after all flower petals have fallen."				
Permethrin	"Do not apply this pesticide to or allow it to drift to blooming crops or weeds while bees are actively visiting the treatment area." " Construct and maintain a minimum 10-foot wide vegetative filter strip of grass or other permanent vegetation between the field edge and down gradient aquatic habitat (such as, but not limited to: lakes; reservoirs; rivers; permanent streams; marshes or natural ponds; estuaries; and commercial fish farm ponds). Only apply products containing permethrin onto fields where a maintained vegetative buffer strip of at least 10 feet exists between the field and down gradient aquatic habitat." "Do not apply within				

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
	25 feet of aquatic habitats (such as, but not limited to: lakes; reservoirs; rivers; permanent streams; marshes; natural ponds; estuaries; and commercial fish ponds)." "Only apply this product if the wind direction favors on-target deposition. Do not apply when the wind velocity exceeds 15 mph." "Do not make aerial or ground applications into temperature inversions." "Use only medium or coarser spray nozzles (for ground and non-ULV aerial application) according to ASAE (S572) definition for standard nozzles." "Wind speed must be measured adjacent to the application site on the upwind side, immediately prior to application. For ground boom applications, apply using a nozzle height of no more than 4 feet above the ground or crop canopy. For airblast applications, turn off outward pointing nozzles at row ends and when spraying the outer two rows. To minimize spray loss over the top in orchard applications, spray must be directed into the canopy."				
Spinosad	"Make localized area treatments of ornamental plants where pest problems are anticipated or occur rather than general area-wide broadcast treatments"				

Table A4-2. Herbicide active ingredients and information on product labels regarding use restrictions

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
Aminopyralid	Milestone	62719-519	Caution	No	48
Clethodim	Envoy Plus	59639-132	Caution	No	24
Clopyralid	Transline	62719-259	Caution	No	12
Dithiopyr	Dimension EC	62719-426	Warning	No	12
Flumioxazin	SureGuard Herbicide	59639-120	Caution	No	12
Glufosinate	Finale	7969-444	Warning	No	12
Glyphosate	Roundup Pro	524-475	Caution	No	4
Hexazinone	Velpar VU	432-1573	Danger	No	48
Indaziflam	Marengo G	432-1523	Caution	No	12
Isoxaben	Gallery 75DF	62719-145	Caution	No	12
Oryzalin	Surflan AS	70506-43	Caution	No	24
Oxyfluorfen	GoalTender	92894-3	Caution	No	24
Paraquat	Gramoxone SL2.0	100-1431	Danger/ Poison	Yes	24
Prodiamine	Barricade 4FL	100-1139	Caution	No	12
Triclopyr BEE	Garlon 4	62719-40	Caution	No	12
Trifluralin	Snapshot 2.5TG	62719-175	Caution	No	12
	Label Mandates				
Aminopyralid	"Do not aerially apply Milestone within 50 feet of a border downwind (in the direction of wind movement), or allow spray drift to come in contact with any broadleaf crop or other desirable broadleaf plants, including, but not limited to, alfalfa, cotton, dry beans, flowers, grapes, lettuce, potatoes, radishes, soybeans, sugar beets, sunflowers, tobacco, tomatoes or other broadleaf or vegetable crop, fruit trees, ornamental plants, or soil where sensitive crops are growing or will be planted." "The applicator is responsible for avoiding off-site spray drift. Be aware of nearby non-target sites and environmental conditions." "Direct sprays no higher than the tops of target vegetation and keep spray pressures low enough to provide coarse spray droplets to minimize drift." "The following drift management requirements must be followed to avoid off-target drift movement from aerial applications: 1. The boom length must not exceed 75% of the fixed wing span and must be located at least 8 to 10 inches below the trailing edge of the fixed wing; the boom length must not exceed 85% of the rotary blade. 2. Nozzles should be pointed backward parallel with the air stream or not pointed downward more than 45 degrees." "Do not apply when weather conditions favor drift to nontarget sites". "Do not apply when wind is gusting or wind speed exceeds 15 mph as uneven spray coverage and drift may result." "Do not apply herbicides if temperature inversion conditions occur in the treatment area."				
Clethodim	"Do not apply where weather conditions favor drift from areas treated." "Apply with the nozzle height recommended by the manufacturer, but no more than 3 feet above the ground or crop canopy. For all other ground applications, the nozzle must be no more than 3 feet from the target vegetation. Applicators are				

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
	required to use a medium or coarser droplet size (ASABE S572.1). Do not apply when wind speeds exceed 10 miles per hour at the application site. Do not apply during temperature inversions."				
Clopyralid	"Do not contaminate water intended for irrigation or domestic purposes. To avoid injury to crops or other desirable plants, do not treat or allow spray drift to fall onto banks or bottoms of irrigation ditches or other channels that carry water that may be used for irrigation purposes." "Use coarse sprays to minimize drift." "Spray only when wind velocity is low (follow state regulations)." "Do not apply by aircraft when an air temperature inversion exists."				
Dithiopyr	"Do not apply when weather conditions favor drift from treated areas." "Do not apply when weather conditions favor drift to non-target areas. This product may injure foliage of non-target plants." "Do not graze livestock or feed forage cut from areas treated with this product." "For ornamentals within non-crop areas, apply only after transplanting when soil around roots has been thoroughly settled by rainfall or irrigation or injury will result." "Apply Dimension EC as a post-directed spray around established ornamentals. Direct sprays to the soil at the base of the ornamentals avoiding contact or drift to foliage."				
Flumioxazin	"For ground boom and aerial applications, use medium or coarser spray nozzles according to ASAE 572 definition for standard nozzles or a volume mean diameter (VMD) of 300 microns or greater for spinning atomizer nozzles." " For ground boom applications, apply with nozzle height no more than 4 ft above the ground or crop canopy." "Do not make aerial or ground applications into areas of temperature inversions."				
Glufosinate	"Do Not apply beyond runoff. Use a coarse spray. Do Not spray during windy conditions." "Do Not apply directly to air allow drift to contact desirable green tissue or green, thin, or uncalloused bark or desirable vegetation or injury may result. Do Not apply Finale as an over-the-top broadcast spray in ornamentals and shade or Christmas trees."				
Glyphosate	"To prevent injury to adjacent desirable vegetation, appropriate buffers must be maintained"				
Hexazinone	"When applied as a liquid spray using water as the carrier, VELPAR® L VU HERBICIDE may be applied by ground equipment or by air (helicopter only)." "The interaction of many equipment and weather-related factors determines the potential for spray drift. The applicator is responsible for considering all these factors when making application decisions. Avoiding spray drift is the responsibility of the applicator." "Every applicator is expected to be familiar with local wind patterns and how they affect spray drift."				
Indaziflam	"Apply INDAZIFLAM G with clean, properly calibrated drop, rotary, hand shaker or other spreader equipment according to the manufacturer's directions." "Do not apply INDAZIFLAM G to drainage ditches."				
Isoxaben	"Apply Gallery 75 Dry Flowable with a properly calibrated low pressure herbicide sprayer that provides uniform spray distribution." "Take precautions to avoid spray drift when applying Gallery 75 Dry Flowable."				
Oryzalin	"Apply Surflan A.S. directly to the soil surface in orchards or vineyards. For orchard crops, including citrus, pome fruits, stone fruits, and tree nuts, apply product only as a strip treatment in the tree rows; do not apply to row middles or drive rows."				
Oxyfluorfen	"Do not apply when weather conditions favor drift to non-target areas." "Do not				

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
	treat ditch banks or waterways with GoalTender or contaminate water used for irrigation or domestic purposes." "A 25 foot vegetative buffer strip must be maintained between all areas treated with this product and lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries and commercial fish farm ponds." "Do not allow spray to drift from the application site and contact people, structures people may occupy at any time and the associated property, parks and recreation areas, non-target crops, aquatic and wetland areas, woodlands, pastures, rangelands, or animals." "For ground boom applications, apply with nozzle height no more than 4 feet above the ground or crop canopy when wind speed is 10 mph or less at the application site as measured by an anemometer." "Use coarse spray according to ASAE 572 definition for standard nozzles or VMD of 475 microns for spinning atomizer nozzles." "The applicator also must use all other measures necessary to control drift." "Apply GoalTender using conventional low-pressure ground spray equipment with flat fan spray nozzles." "Use directed sprays and spray shields and/or leaf lifters as necessary to minimize contact of spray or drift with crop foliage or stems."				
Paraquat	"Applicators must complete an EPA-approved paraquat training" "Apply as a coarse spray to avoid crop injury from fine spray mist"				
Prodiamine	"Apply Barricade 4FL in a minimum of 20 gal /A (0.5 gal /1000 sq ft) of carrier (water and/or fluid fertilizer) using a calibrated, low-pressure sprayer with 50-mesh or coarser screens."				
Triclopyr BEE	"Do not apply with nozzles that produce a fine droplet spray." "Do not spray when wind is blowing toward susceptible crops or ornamental plants that are near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray." For aerial applications, "The distance of the outer most operating nozzles on the boom must not.exceed 3/4 the length of the rotor. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees."				
Trifluralin	"Apply Snapshot 2.5 TG using a drop or rotary-type spreader designed to apply granular herbicides or insecticides."				

Table A4-3. Fungicide active ingredients and information on product labels regarding use restrictions

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
Azoxystrobin	Heritage Fungicide	100-1093	Caution	No	4
Chlorothalonil	Bravo Ultrex	66222-277	Danger	No	12
Fludioxonil	Medallion WDG	100-1434	Caution	No	12
Flutolanil	Prostar 70WP	432-1223	Caution	No	12
Metconazole	Tourney	59639-144	Caution	No	12
Myclobutanil	Eagle 20EW	62719-463	Caution	No	24
Propiconazole	Tilt	100-617	Warning	No	24
	Label Mandates				
Azoxystrobin	"DO NOT apply Heritage Fungicide when conditions favor drift beyond the area intended for application." "DO NOT apply when weather conditions favor drift from treated areas to a non-target aquatic habitat." "Avoiding spray drift is the responsibility of the pesticide applicator."				
Chlorothalonil	"This product must not be applied within 150 feet for aerial applications, or 25 feet for ground applications of marine/estuarine water bodies, unless there is an untreated buffer area of that width between the area to be treated and the water body." "Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions." "When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation."				
Fludioxonil	"Observe the following precautions when spraying in the vicinity of aquatic areas such as lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds." "Do not apply within 75 ft of bodies of water such as lakes, reservoirs, rivers, permanent streams, natural ponds, marshes or estuaries." "For all plantings within 150 ft of bodies of water as described above, spray crops from outside the planting away from the bodies of water." "Shut off the sprayer when at row ends." "Spray the last three rows windward of aquatic areas using nozzles on one side only, with spray directed away from aquatic areas." "Do not cultivate within 10 ft of aquatic areas as to allow a vegetative filter strip." "Do not apply when weather conditions favor drift to aquatic areas." "Do not apply when gusts or sustained winds exceed 10 mph." Do not apply during a temperature inversion. Mist or fog may indicate the presence of an inversion in humid areas." "The applicator is responsible for avoiding off-site spray drift. Be aware of nearby non-target sites and environmental conditions." "When making applications in hot and dry conditions, use larger droplets to reduce effects of evaporation."				
Flutolanil	"To reduce the potential for drift, the application equipment must be set to apply medium to large droplets (i.e., ASAE Standard 572) with corresponding spray pressure." Under Use Precautions heading, "For use rates over 2.2 oz per 1,000 square ft, do not apply PROSTAR 70WP Fungicide within 100 ft. of any estuary or marine habitat or within 100 feet of any ditches, drainage tiles, or other waterways that drain directly into (within 1/2 mile of) estuaries or marine habitats."				

Active Ingredient	Product Formulation	EPA Registration Number	Signal Word	Restricted Use?	Restricted Entry Interval
Metconazole	"It is the responsibility of the applicator to ensure that spray drift does not occur. Do not apply this product when weather conditions favor spray drift from treated areas. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator is responsible for considering all of these factors when making decisions. Where states have more stringent regulations, they must be observed." "Apply Tourney Fungicide using standard, low-pressure spray equipment designed to deliver coarse to medium size spray droplets (do not use nozzles designed to deliver fine droplets). "Do not position the spray boom more than 20 inches above the turf."				
Myclobutanil	"Do not apply when weather conditions favor drift or runoff from areas treated."				
Propiconazole	"Do not apply in a manner that will result in exposure to humans or animals." "To avoid spray drift, DO NOT apply when conditions favor drift beyond the target area." "Apply with the nozzle height recommended by the manufacturer, but no more than 3 feet above the ground or crop canopy. For all applications, applicators are required to use a medium to ultra coarse spray droplet size (ASABE S572.1). Do not apply when wind speeds exceed 10 miles per hour at the application site. Do not apply during temperature inversions." "The applicator is responsible for avoiding off-site spray drift". "When making applications in hot and dry conditions, use larger droplets to reduce effects of evaporation."				