

# Proposed Toxic Air Contaminant Control Measure for Chlorpyrifos

## July 1, 2019

The Department of Pesticide Regulation (DPR) is charged with protecting human health and the environment by eliminating from use in California any pesticide that endangers public health or the agricultural or nonagricultural environment. This document invites consultation on DPR's proposed control measure to cancel registrations of chlorpyrifos based on the July 2018 Risk Characterization Document (2018 RCD) and May 28, 2019 Risk Management Directive (RMD).

### **Background and Toxic Air Contaminant (TAC) Process**

Chlorpyrifos is a pesticide used to control a variety of insects on more than 60 crops, with the most common uses in California for nut trees, alfalfa, citrus, cotton, and several other food crops. Common use areas include the Central Valley, Central Coast region, and Imperial County. Although the use of chlorpyrifos in California is declining, there are currently several dozen chlorpyrifos products registered for use in California by approximately 20 different companies. In the agricultural context in particular, chlorpyrifos product labels allow for applications by aircraft, orchard and vineyard tractor airblast sprayers, and tractor ground boom, as well as granular applications, applications using irrigation systems, and other applications. Beginning in January 2019, DPR recommended that the county agricultural commissioners require more restrictive permit conditions for chlorpyrifos. These included a prohibition on aerial applications, quarter-mile buffer zones, and limiting ground applications to certain crop/pest combinations that lack alternatives. These recommendations will remain in place during the TAC process described below. As discussed below, very low levels of exposure to chlorpyrifos result in serious adverse effects because of chlorpyrifos's high toxicity.

DPR finalized the 2018 RCD for chlorpyrifos in July 2018 after review by the Office of Environmental Health Hazard Assessment (OEHHA) and the Scientific Review Panel (SRP) as part of the TAC process outlined in Food and Agricultural Code (FAC) sections 14021-14026. Consistent with the recommendation of the SRP, DPR calculated a 4.05 micrograms of chlorpyrifos per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ) reference concentration and 0.0001 milligrams of chlorpyrifos per kilogram body weight per day (mg/kg/day) reference dose using a point of departure based on developmental neurotoxic (DNT) effects. (Reference concentration/dose refers to the level at or below which exposure to chlorpyrifos would have negligible risk to human health.) DPR based the reference concentration and dose for chlorpyrifos on a comprehensive review of studies looking specifically at DNT effects, including recent animal studies. The 2018 RCD evaluated direct exposure to chlorpyrifos from spray drift, including inhalation, incidental hand-to-mouth, and dermal exposures; dietary exposure; drinking water exposure; and aggregate exposures.

Based on the 2018 RCD, DPR amended California Code of Regulations (CCR), title 3, section 6860 to list chlorpyrifos as a TAC. The Office of Administrative Law approved the regulation on January 31, 2019, and the regulation became effective on April 1, 2019. Once a pesticide is listed as a TAC, DPR is charged with determining, "in consultation with [OEHHA], the California Air Resources Board, and local air pollution control districts or air management districts in affected counties, the need for and appropriate degree of control measures..." (FAC section 14023(e).) For those pesticides for which a need for control measures has been determined, DPR "shall develop control measures to reduce emissions sufficiently so that the source will not expose the public to the levels of exposure that may cause or contribute to

significant adverse health effects.” (FAC section 14024(a).) Under FAC section 14024(b), label changes, regulations, and cancellation are among the control measures DPR may use to reduce exposure to TAC pesticides to protect public health.

Pursuant to FAC section 14023(e), DPR consulted on the need for and appropriate degree of control measures by soliciting comments from OEHHA, the California Air Resources Board (ARB), and local air pollution control districts or air management districts in affected counties on a proposed RMD. DPR also consulted with the California Department of Food and Agriculture per a memorandum of understanding (MOU) between the departments. The proposed RMD selected the regulatory target concentration and dose of 4.05 µg/m<sup>3</sup> and 0.0001 mg/kg/day for chlorpyrifos, which is consistent with the reference concentration and reference dose from the 2018 RCD. (The regulatory target concentration/dose is the level that DPR’s control measures should meet.) DPR determined that bystander exposure to chlorpyrifos above the selected regulatory target concentration or dose is associated with developmental neurotoxic (DNT) effects in children and sensitive populations that include altered cognition, motor control, and behavior. These effects are serious and adverse and demonstrate that exposure to chlorpyrifos above the reference concentration and dose is detrimental to public health. DPR further determined in its proposed RMD that additional control measures beyond the recommended permit conditions are necessary to reduce bystander exposures to chlorpyrifos to health protective levels.

OEHHA, ARB, and local air pollution control districts or air management districts in affected counties submitted comments agreeing with DPR’s determination on the need for and appropriate degree of control measures to protect human health. CDFA also submitted comments under the MOU. On May 28, 2019, DPR finalized the RMD.

Pursuant to FAC section 14024(a), DPR now turns to the control measures necessary to reduce bystander exposure to chlorpyrifos to health protective levels. As outlined below, DPR has determined that even when properly used, use of chlorpyrifos products is detrimental to public health. Specifically, use of chlorpyrifos products consistent with the recommended interim permit conditions, label application rates, and other requirements does not limit exposures from spray drift and dietary sources to the regulatory target concentration and dose, and such use cannot be further mitigated. These exposures are associated with DNT effects in children and infants and are detrimental to public health. As such, pursuant to FAC section 12825, DPR is proposing to cancel registrations of chlorpyrifos products that would result in unacceptable exposures. Please review this document and provide comments to DPR regarding the proposed control measure by July 19, 2019.

### **Estimated Bystander Exposures to Chlorpyrifos**

The 2018 RCD indicates that chlorpyrifos exposure to bystanders primarily occurs from spray drift, food residues, and drinking water.

Bystander exposures from spray drift include inhalation, dermal, and incidental oral (child hand-to-mouth exposure from contaminated surfaces). Spray drift exposure varies with method of application and application rate, and decreases when increasing the distance from the application.

Exposures from food residues result from dietary consumption. The 2018 RCD indicates that chlorpyrifos exposure from food residues alone is approximately four times the regulatory target dose (0.0001

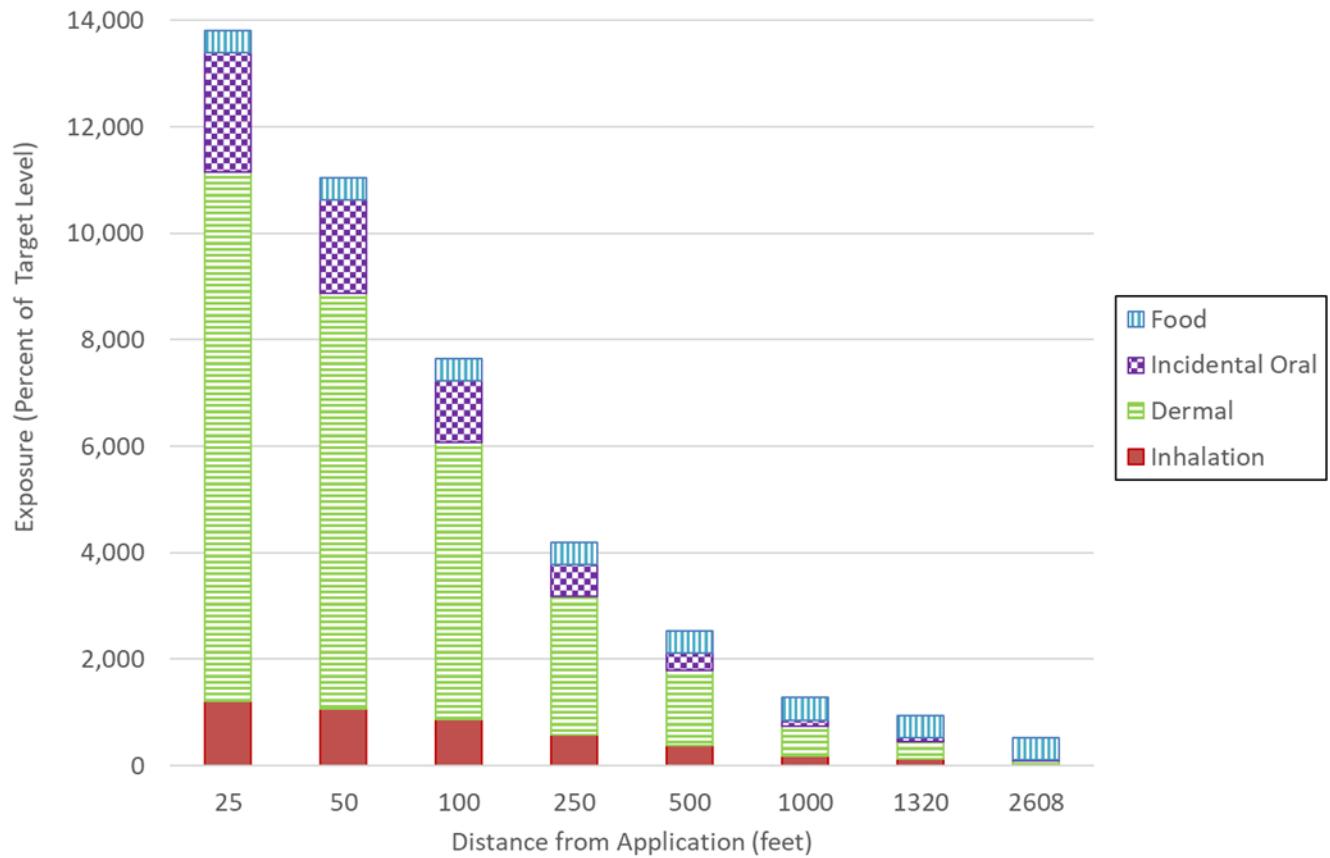
mg/kg/day). This includes consumption of foods grown in California, as well as those imported from other states and countries.

While the 2018 RCD identified drinking water exposures exceeding the regulatory target dose, further evaluations of chlorpyrifos concentrations in California surface water and groundwater, which are the primary sources for drinking water in California, indicate that there is currently minimal chlorpyrifos exposure through that route.

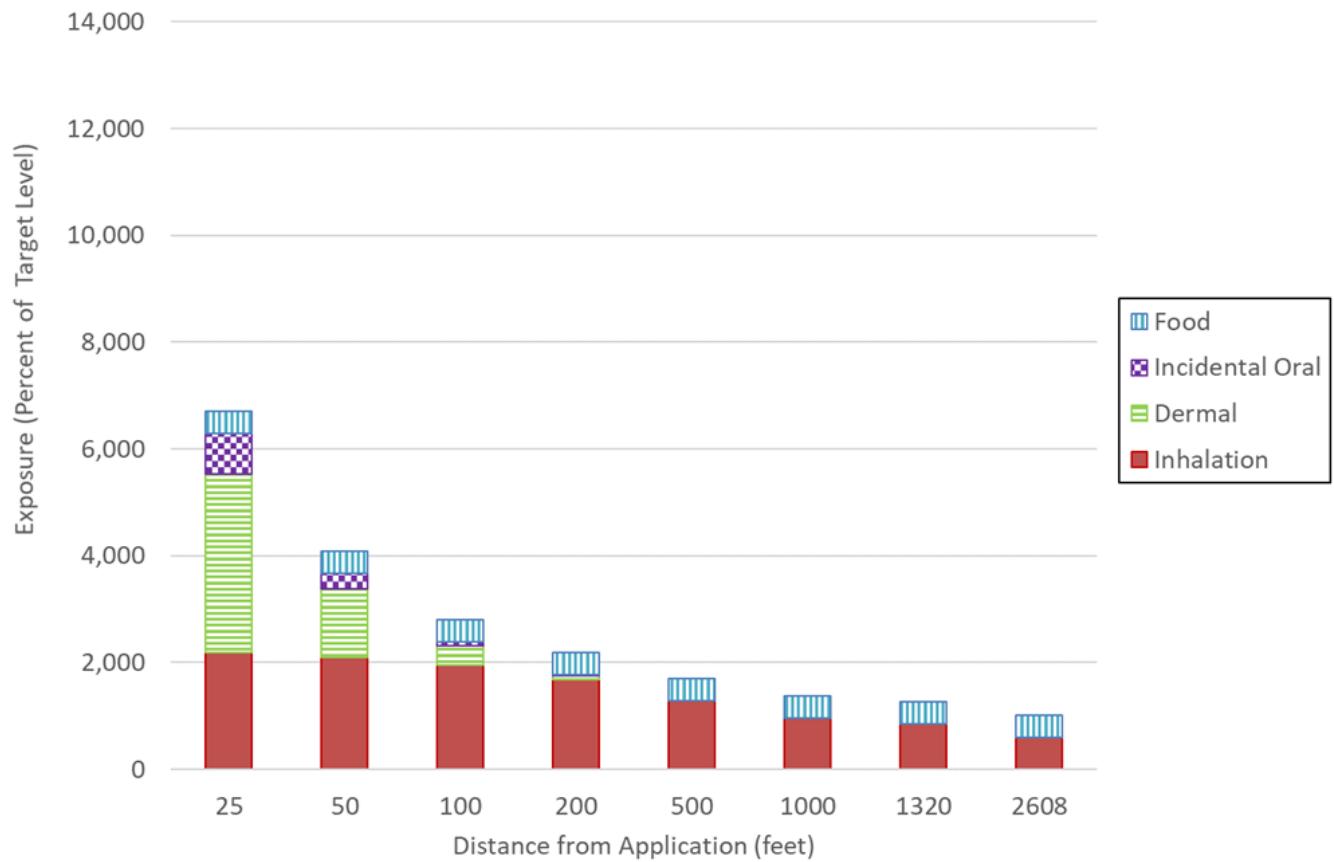
Figures 1-3 show two examples of estimated chlorpyrifos exposures to bystanders relative to the selected regulatory target concentration and dose. Note that while spray drift exposures decrease as the distance from the application increases, food residue exposures remain constant regardless of the distance from the application. The figures are based on information included in the 2018 RCD and an updated analysis of air concentrations and estimated inhalation exposure from ground applications using airblast. The figures assume an application rate of 2 pounds per acre for a 40 acre application, which is the average application rate and size for chlorpyrifos applications.

Figure 1 shows the relative contribution of estimated chlorpyrifos exposure from spray drift (inhalation, incidental oral, and dermal) and food residue for infants or children from aerial applications. Figure 2 shows the same information for ground applications. The contributions are calculated at a variety of distances from the application and are expressed as a percentage of the regulatory targets. Exposures of 100 percent or less meet the regulatory target, whereas aggregate exposures over 100 percent exceed the regulatory target. In all cases, the aggregate estimated exposure exceeds the regulatory target. Figure 3 shows the same information as Figures 1 and 2 for 2608 feet, but on a different scale to make the 0.0001 mg/kg/day regulatory target dose (100%) visible.

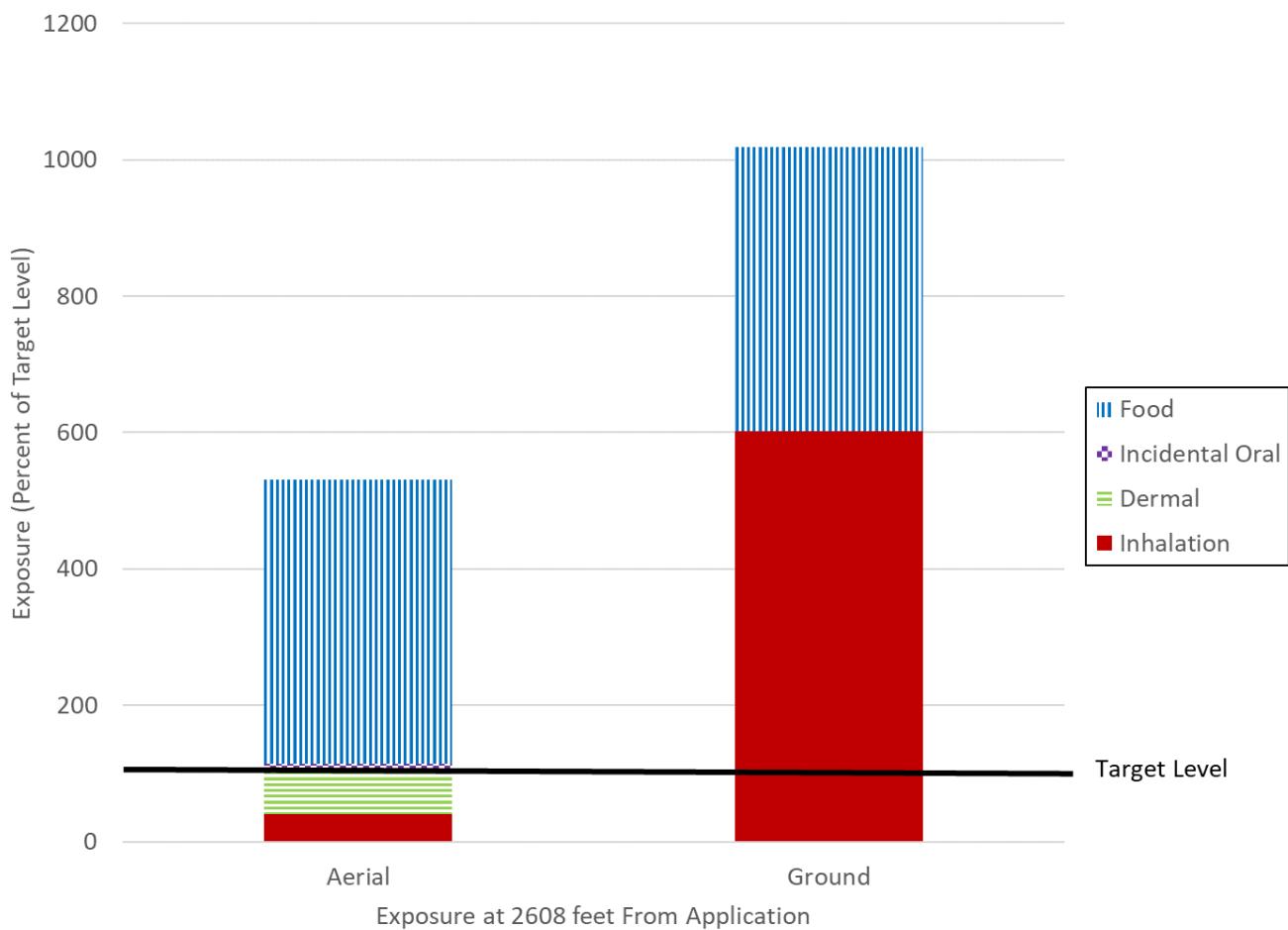
*Figure 1. Estimated chlorpyrifos infant/child exposure from aerial applications (two pounds per acre application rate) based on a regulatory target concentration of 4.05 µg/m<sup>3</sup> and regulatory target dose of 0.0001 mg/kg/day.*



*Figure 2. Estimated chlorpyrifos infant/child exposure from ground applications (two pounds per acre application rate, 40 acres) based on a regulatory target concentration of 4.05 µg/m<sup>3</sup> and regulatory target dose of 0.0001 mg/kg/day.*



*Figure 3. Estimated chlorpyrifos infant/child exposure at 2608 feet from aerial and ground applications (two pounds per acre application rate, 40 acres) based on a regulatory target concentration of 4.05 µg/m<sup>3</sup> and regulatory target dose of 0.0001 mg/kg/day.*



### Evaluation of Proposed Chlorpyrifos Control Measures

Under FAC section 14024(b), the control measures DPR may use to reduce exposure to TAC pesticides using include, but are not limited to:

- Reclassification as a restricted material
- Restrictions on use patterns or locations
- Changes in application procedures
- Applicator training
- Label amendments
- Cancellation

In 2015, DPR classified chlorpyrifos as a restricted material. This requires applicators be certified prior to possession and use. Additionally, applicators are required to obtain a permit from the appropriate county agricultural commissioner (CAC) prior to use. Applicators are required to use a restricted material consistent with permit conditions required by the local CAC. After classifying chlorpyrifos as restricted material, DPR recommended CACs implement interim permit conditions on all chlorpyrifos permits to restrict use patterns and applications procedures.

Beginning in January 2019, DPR recommended CACs implement more restrictive permit conditions. DPR's recommended interim permit conditions prohibit aerial applications, add limitations to airblast application procedures, place restrictions on use patterns, institute buffer zones of up to a quarter mile, limit applications to 40 acres or less, and restrict use to certain crop/pest combinations without acceptable pesticide alternatives.

While the current control measures related to chlorpyrifos offer protection, they do not reduce exposures to the selected regulatory target concentration or dose. Specifically, the current recommended interim permit conditions require setbacks of 1320 feet (one quarter of a mile) for certain allowable uses. However, DPR determined that spray drift exposure to chlorpyrifos beyond this distance under the current recommended permit conditions is associated with DNT effects. While additional control measures are necessary, DPR is unable to implement or recommend feasible control measures to mitigate exposure beyond this distance. Further, the setbacks provide no protection against dietary exposure. As such, proper use of chlorpyrifos products is detrimental to public health. DPR therefore proposes cancellation of chlorpyrifos products<sup>1</sup> pursuant to FAC section 12825 as the appropriate control measure to mitigate chlorpyrifos exposures from spray drift or dietary sources.

#### *Spray Drift Exposure to Chlorpyrifos*

The 2018 RCD identified unacceptable inhalation, incidental hand-to-mouth, dermal, and aggregate exposures from spray drift to bystanders living and working near chlorpyrifos application sites. Detrimental health effects from spray drift exposure are associated with current uses of chlorpyrifos products.

Reducing chlorpyrifos spray drift exposure to acceptable levels would require local CACs to establish enforceable setbacks for occupied and unoccupied sites to protect infants and children, and buffer zones to protect adults. This would require the local CAC to monitor, supervise, and enforce multiple areas of varying size and duration surrounding the application site for a single application. DPR determined that it is not feasible for the CACs to enforce setbacks or buffer zones for chlorpyrifos that are greater than 1320 feet (one quarter of a mile), particularly considering that CACs must enforce multiple areas of varying size and duration around the application site.

A setback is a distance between a sensitive site (as defined by chlorpyrifos labels) and an application site, and is used to mitigate exposure to infants and children because they are the most sensitive populations.<sup>2</sup>

---

<sup>1</sup> Products that, based upon their registered uses, are not currently identified as causing spray drift or dietary residue exposures of concern are not subject to DPR's current cancellation proposal.

<sup>2</sup> In many cases, buffer zones are synonymous with setbacks, but in this context, they differ. A buffer zone, used to mitigate exposure to adults in addition to infants and children, is an area surrounding an application site where only handling and transit are allowed.

The setback distances for chlorpyrifos applications vary depending on application-specific factors, including application rate and size of the treated area.

DPR's analysis of pesticide use reports (PUR)<sup>3</sup> and chlorpyrifos product labels indicates that the vast majority of proper chlorpyrifos use in California would require a setback distance of more than 1320 feet to adequately protect children and infants. The PUR data represents actual use of chlorpyrifos at levels that applicators believe to be effective. Table 1 shows that according to the most recent available PUR data, over 97% of ground applications would require a setback distance larger than 1320 feet in order to reduce exposures to acceptable levels. Due to the low target regulatory target concentration associated with DNT effects, currently allowable chlorpyrifos applications are detrimental to public health.

*Table 1. Use of chlorpyrifos products by ground applications that result in exposures of concern for the top ten crops during 2017. These crops account for more than 90 percent of chlorpyrifos use. Percent of ground applications requiring setbacks of greater than 1320 feet was determined based on the regulatory target dose of 0.0001 mg/kg/day of chlorpyrifos.*

Crop	Pounds of Use for Ground Applications	Acres Treated with Ground Applications	Number of Ground Applications	Percent of Ground Applications Requiring Setbacks Greater than 1320 feet*
Orange	153,719	38,123	1429	96.8%
Walnut	95,018	50,649	1183	99.0%
Almond	136,931	77,272	972	97.4%
Alfalfa	25,717	46,055	893	82.0%
Grapes	59,824	35,424	813	97.0%
Lemon	34,062	10,405	479	86.0%
Grapes, wine	49,416	26,340	339	99.4%
Tangerine	30,450	14,764	328	93.9%
Cotton	27,428	29,111	323	96.9%
Sugarbeet	9,108	12,931	132	100.0%
<b>TOTAL</b>	<b>621,673</b>	<b>341,074</b>	<b>6891</b>	<b>97.5%</b>

\* Consistent with the 2018 RCD, and in order to protect human health as required by the TAC statute, DPR used chlorpyrifos airblast application data for all ground applications.

Table 2 shows the estimated setback distances necessary to mitigate spray drift exposure to the selected regulatory target concentration and dose. DPR calculated the setbacks based on information in the 2018 RCD, and an updated analysis of air concentrations and estimated inhalation exposure from airblast applications, which was used for all ground applications. Both the setback distances and duration apply to occupied sensitive sites, and provide protection for inhalation and direct dermal exposure during and shortly after an application.

---

<sup>3</sup> Under California law, all agricultural pesticide use must be reported monthly to CACs, who in turn, report the data to DPR.

DPR also conducted additional modeling of aerial applications using AGricultural DISPersal (AGDISP) for droplet sizes of 100 µm or less to account for the fraction of droplets that are inhalable, which showed that all droplets 250 feet or more from the application site are inhalable. Since Table 2 shows that all aerial setbacks are 200 feet or greater, no adjustments were needed to account for the inhalable fraction.

*Table 2. Estimated chlorpyrifos setback distances for 40-acre applications needed to reduce spray drift exposures to the regulatory target dose of 0.0001 mg/kg/day, including an air concentration of 4.05 µg/m<sup>3</sup> and equivalent targets for dermal and incidental oral exposures, based on application rate of chlorpyrifos in pounds of active ingredient per acre.*

Application Rate (pounds /acre)	Setback Distance by Application Method		Setback Duration (hr)
	Aerial*	Ground Applications**	
0.1	200 ft (0.04 mi)	100 ft (0.02 mi)	9
0.2	500 ft (0.1 mi)	900 ft (0.2 mi)	20
0.33	1,800 ft (0.3 mi)	2,600 ft (0.5 mi)	20
0.5	>2608 ft (>0.5 mi)	4,800 ft (0.9 mi)	20
1	>2608 ft (>0.5 mi)	11,300 ft (2.1 mi)	44
2	>2608 ft (>0.5 mi)	19,100 ft (3.6 mi)	58
3	Labels prohibit	26,700 ft (5.0 mi)	58
4	Labels prohibit	36,900 ft (7.0 mi)	58

\* Assumes a spray volume of 15 gallons/acre. AGDISP model used for aerial applications does not provide estimates for distances greater than 2,608 feet.

\*\* Consistent with the 2018 RCD, and in order to protect human health as required by the TAC statute, DPR used chlorpyrifos airblast application data for all ground applications.

As shown in Table 2, chlorpyrifos applications made at lower rates require relatively short setback distances. However, such applications are only efficacious for a limited number of pest-crop combinations and, as shown in Table 1, represent a small amount of actual chlorpyrifos use. The setbacks shown in Table 2 that are representative of actual chlorpyrifos use are significantly greater than 1320 feet. As such, the setbacks in the recommended interim permit conditions would not be adequately protective of public health for these applications.

Further, it is not feasible for DPR to require a setback distance that is larger than one quarter mile (1320 feet) to reduce exposures for these applications to permissible levels for several reasons. First, chlorpyrifos is often part of integrated pest management (IPM) systems. As part of an IPM program, chlorpyrifos is only applied when monitoring indicates an immediate and often unforeseeable pest pressure. Chlorpyrifos applications must be made immediately after observing a pest and prior to the population exceeding a threshold, because any delay in treatment will cause pest levels to increase, requiring use of a greater amount of pesticide. As a result, there is a small window of time between identifying a pest pressure and making a pesticide application. This compressed timeline compromises a grower's or CAC's ability to adequately assess and plan for the large setback around an application.

The large size of the setbacks is also infeasible for applicators to comply with, and for CACs to enforce. In order for applicators to comply with, and for CACs to enforce, the setbacks listed above in Table 2, the locations of all sensitive sites must be identified. While the locations of some sensitive sites are known (e.g., schools and day care centers), it is infeasible for CACs and applicators, in the short amount of time

between identifying a pest pressure and making a chlorpyrifos application, to locate and ensure bystanders are not present in the exceptionally large number and variety of other sensitive sites on the product label (e.g., residential lawns and pedestrian sidewalks) within a setback for the entire duration of the setback. Moreover, in the event a setback extends into other properties, written permission from the other property operators must be obtained and other property operators must agree to notify and keep people out of the sensitive site. This process can take several days, at a minimum, which further makes the large setbacks outlined in Table 2 infeasible.

*Table 3. Approximate area regulated and total perimeter distance, assuming the treated area is a 40-acre square.*

Setback Distance (mi)	Area Regulated (treated area + setback area in square mi)	Setback Perimeter Distance (mi)
0.25	0.6	3.0
0.5	1.5	5.0
1.0	5.0	9.0
2.1	20.5	18.1
3.6	56.0	29.9
5.0	107.4	41.5
7.0	202.4	56.9

Table 3 shows that the total area regulated by setback distances identified in Table 2 would be approximately 1.5 to 200 square miles. Even for shorter setback distances, it is infeasible for CACs and applicators to ensure that no sensitive sites are occupied in an area this large during the entire 24-60+ hour period between when the application occurs and until reentry is permitted.

In addition to the setback for occupied sites, a second, shorter, but likely permanent setback would be needed for sensitive sites unoccupied during application for 48-60+ hours. The second setback is needed to provide protection from indirect dermal and oral exposure of contaminated surfaces. The CAC would be required to enforce this setback for at least several weeks after an application.

Further, an additional buffer zone around chlorpyrifos applications would be needed to provide protection for adult workers, particularly farmworkers, in nearby areas. The buffer zone distances would be shorter than the occupied setback distances, but the only activities allowed within the buffer would be chlorpyrifos application (handling) tasks and transit. Fumigant buffer zones require postings at the perimeter points of entry (e.g., roads, sidewalks, paths) so that people know entry is prohibited; a similar requirement would be necessary for chlorpyrifos. This would likely take the applicator more than a day to complete and would be infeasible for a CAC to enforce.

Establishing and enforcing two setbacks and one buffer zone, which all have varying distances, durations, and restrictions on who can enter, to effectively mitigate the serious adverse effects of chlorpyrifos exposure from spray drift is exceedingly and logically complex, and ultimately infeasible for CACs and applicators to manage as a practical matter.

#### *Dietary Exposure to Chlorpyrifos*

The 2018 RCD indicates that chlorpyrifos exposure from food residues alone is approximately four times the regulatory target dose (0.0001 mg/kg/day). Detrimental effects from dietary exposure occur in

addition to and apart from the unacceptable effects of spray drift exposures. Food residues occur from the legal use of chlorpyrifos products. Specifically, use of chlorpyrifos products consistent with the registered label spray rates, applications methods, and other use requirements results in unacceptable dietary exposures. DPR is proposing cancellation of chlorpyrifos products that result in dietary exposure from residue because the proper use of these products results in residue levels that are associated with DNT effects in children and infants.

## **Conclusion**

In the 2018 RCD, DPR scientists calculated a reference concentration and dose for chlorpyrifos using a point of departure based on DNT effects. Based on the 2018 RCD, DPR listed chlorpyrifos as a TAC. (3 CCR section 6860.) In the May 28, 2019 RMD, DPR determined, in consultation with OEHHA, ARB, and local air districts in affected counties that current chlorpyrifos exposures exceed DPR's selected regulatory target concentration and dose, and additional control measures are needed to protect human health. DPR is proposing to cancel registrations of chlorpyrifos products currently known to cause spray drift or dietary exposures because DNT effects occur at very low levels of exposure. In addition, DPR has determined that proper use of chlorpyrifos products that cause spray drift or dietary exposures is detrimental to public health.