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MEMORANDUM

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DATE: October 6, 2016

SUBJECT: UPDATED (NO DECEMBER APPLICATIONS ALLOWED) SIMULATION OF CANCER RISKS ASSOCIATED WITH DIFFERENT TOWNSHIP CAP SCENARIOS OF MERCED COUNTY FOR 1,3-DICHLOROPROPENE

I. BACKGROUND

The purpose of this update is to highlight changes in methodology for estimating the lifetime exposure of residential bystanders to 1,3-dichloropropene (1,3-D) in Merced, CA using the SOil Fumigant Exposure Assessment System (SOFEA©) and the Monte Carlo Annual-Based Lifetime Exposure model (MCABLE), both are Microsoft Excel applications, as described in a draft paper by Barry and Kwok dated May 12, 2016 (attached).

II. METHODOLOGY

In this updated simulation, no applications are allowed during the month of December. The applications listed during the month of December were reallocated proportionally to the preceding months of January to November. The reallocation of applications retains the annual township cap of 9500 gallons per township per year. The application reallocation is an attempt to alleviate the maximum 1,3-D air concentrations measured in December at Merced, CA (Barry, 2015). In the SOFEA model, 1,3-D applications are assigned randomly to days using separate worksheets for each crop type. The crop type varies by location. For the Merced SOFEA simulations, the crop type worksheets employed were TV_App_Date (tree and vine), NC_App_Date (nursery crop), and SB_App_Date (strawberry & row crop). The application dates listed in these three worksheets are from the actual use records of 1,3-D in Merced, CA in 2011 (AGRIAN, 2016). The reallocation process is shown in the numbered steps below:

1) For a crop type application date worksheet, the number of applications that occur in December (e.g. Day 335 to 365 for 2011) is calculated.
2) Reallocation of the total number of December applications to the remaining months is based on the proportion of the remaining applications calculated in each of the preceding 11 months (January through November).
3) Within each month, the uniform distribution was use to generate a set of random numbers between 1 and 31, 1 and 28, or 1 and 30 (depending on the month). The reallocation of December applications is accomplished by assigning an application date to a random number date in ascending order.

Table 1 shows the reallocation results for the “No December Applications Allowed” SOFEA model runs. Nursery crops (NC) did not have any applications in December, so no changes were necessary to the NC_App_Date worksheet. In the remainder of this memorandum, the No December Applications Allowed scenario will be designated “with reallocation” and the December Applications Allowed scenario will be designated “without reallocation.” Three township cap scenarios were run with reallocation and without reallocation: Baseline, Max, and 1.5xCap. See the draft paper by Barry and Kwok dated May 12, 2016 (attached) for details of the township cap scenarios.

Table 1. Reallocation of the number of Merced strawberry & row crops (SB) and tree & vine (TV) application dates to months other than December (within the same calendar year).

Month	**SB**		**TV**	
	Without Reallocation Applications	With Reallocation Applications	Without Reallocation Applications	With Reallocation Applications
January	77	93	5	7
February	11	13	49	73
March	268	323	4	6
April	345	415	3	4
May	80	96	1	2
June	4	5	1	2
July	2	3	0	0
August	0	0	1	2
September	1	1	0	0
October	22	25	8	12
November	198	238	48	71
December	204	0	59	0
Total	1212	1212	179	179

III. SIMULATION RESULTS

Table 2 shows the estimated cancer risk of individuals living their entire lifetime (i.e., 70 years) in a high 1,3-D use area using MACBLE. As indicated in Table 2, cancer risk increases with increasing township caps (i.e., from baseline to 1.5xCap) and amounts of time spent in the high 1,3-D use area (i.e., from intermediate to low mobility). At baseline, the cancer risk values associated with both mobility scenarios are slightly lower with reallocation than the simulation run without reallocation of the December applications (Table 2 and Table 3, respectively). However, as 1,3-D use increases above baseline, the Max and 1.5x Cap scenarios show higher cancer risk values with reallocation (Table 2) than without reallocation (Table 3). Based on the results from MACBLE, the Max scenario with reallocation shows cancer risk values that are ~8% higher than without reallocation. The 1.5x Cap scenario with reallocation shows cancer risk values that are ~80% higher without reallocation.

Table 2. 1,3-D Cancer Risks[a] at Different Township Cap Values and Mobility Scenarios for No December Applications Allowed (with reallocation).

Township Cap	**Stochastic (Latin Hypercube)**	**Mobility**	**Male**	**Female**
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	1.38 x 10^{-5}	1.26 x 10^{-5}
At Max. (All Township)	70-Year Township 5 only	Low	6.98 x 10^{-6}	6.47 x 10^{-6}
At Baseline (Merced)	70-Year Township 5 only	Low	4.83 x 10^{-6}	4.53 x 10^{-6}
At 1.5x Cap (All Township)	70-Year Township 5 “Home”	Intermediate	1.28 x 10^{-5}	1.17 x 10^{-5}
At Max. (All Township)	70-Year Township 5 “Home”	Intermediate	6.46 x 10^{-6}	5.90 x 10^{-6}
At Baseline (Merced)	70-Year Township 5 “Home”	Intermediate	4.52 x 10^{-6}	4.21 x 10^{-6}
Township Cap	**Point (95th %tile Mean Values)**	**Mobility**	**Min[b]**	**Max[b]**
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	1.35 x 10^{-5}	1.92 x 10^{-5}
At Max. (All Township)	70-Year Township 5 only	Low	7.40 x 10^{-6}	1.15 x 10^{-5}
At Baseline (Merced)	70-Year Township 5 only	Low	1.52 x 10^{-6}	1.07 x 10^{-5}

[a] The individual risk value that constituted the cancer risk distribution was calculated as the LADD (μg/kg/day) multiplied by the human cancer potency factor of 0.000014 [μg/kg/day]$^{-1}$ for portal-of-entry effect. For cancer risk associated with systemic mode-of-action (MOA), all the risk values will be increased by ~3.4 times (i.e., 0.000048 [μg/kg/day]$^{-1}$/0.000014 [μg/kg/day]$^{-1}$ ≈ 3.4).

[b] Corresponding simulated air concentrations of 1,3-D are provided in Table 4.

Table 3. 1,3-D Cancer Risks[a] at Different Township Cap Values and Mobility Scenarios under December Applications Allowed (without reallocation).

Township Cap	Stochastic (Latin Hypercube)	Mobility	Male	Female
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	7.58 x 10^{-6}	7.16 x 10^{-6}
At Max. (All Township)	70-Year Township 5 only	Low	6.41 x 10^{-6}	5.94 x 10^{-6}
At Baseline (Merced)	70-Year Township 5 only	Low	4.99 x 10^{-6}	4.58 x 10^{-6}
At 1.5x Cap (All Township)	70-Year Township 5 “Home”	Intermediate	7.01 x 10^{-6}	6.54 x 10^{-6}
At Max. (All Township)	70-Year Township 5 “Home”	Intermediate	6.05 x 10^{-6}	5.52 x 10^{-6}
At Baseline (Merced)	70-Year Township 5 “Home”	Intermediate	4.62 x 10^{-6}	4.23 x 10^{-6}
Township Cap	**Point (95th %tile Mean Values)**	**Mobility**	**Min[b]**	**Max[b]**
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	1.30 x 10^{-5}	1.77 x 10^{-5}
At Max. (All Township)	70-Year Township 5 only	Low	7.11 x 10^{-6}	1.14 x 10^{-5}
At Baseline (Merced)	70-Year Township 5 only	Low	6.62 x 10^{-6}	9.84 x 10^{-6}

[a] The individual risk value that constituted the cancer risk distribution was calculated as the LADD (μg/kg/day) multiplied by the human cancer potency factor of 0.000014 [μg/kg/day]$^{-1}$ for portal-of-entry effect. For cancer risk associated with systemic mode-of-action (MOA), all the risk values will be increased by ~3.4 times (i.e., 0.000048 [μg/kg/day]$^{-1}$/0.000014 [μg/kg/day]$^{-1}$ ≈ 3.4).

[b] Corresponding simulated air concentrations of 1,3-D are provided in Table 5.

Table 4. Simulated 1,3-D Concentrations at Different Township Cap Values and Mobility Scenarios under No December Applications Allowed (with reallocation)

Township Cap	Point (95th %tile Mean Values)	Mobility	Min	Max
			(μg/m^3)	
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	3.54	4.90
At Max. (All Township)	70-Year Township 5 only	Low	1.89	2.94
At Baseline (Merced)	70-Year Township 5 only	Low	0.39	2.74
			(ppb)[a]	
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	0.78	1.08
At Max. (All Township)	70-Year Township 5 only	Low	0.42	0.65
At Baseline (Merced)	70-Year Township 5 only	Low	0.09	0.60

[a] Conc. (ppb) = Conc. (μg/m3) x 1/10^6 (g/μg) x 1/1000 (m^3/L) x 24.25 (L/mole) x 1/110.98 (mole/g) x 10^9

Table 5. Simulated 1,3-D Concentrations at Different Township Cap Values and Mobility Scenarios under December Applications Allowed (without reallocation).

Township Cap	Point (95th %tile Mean Values)	Mobility	Min	Max
				(µg/m^3)
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	3.33	4.52
At Max. (All Township)	70-Year Township 5 only	Low	1.81	2.91
At Baseline (Merced)	70-Year Township 5 only	Low	1.69	2.51
				(ppb)[a]
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	0.73	1.00
At Max. (All Township)	70-Year Township 5 only	Low	0.40	0.64
At Baseline (Merced)	70-Year Township 5 only	Low	0.37	0.55

[a] Conc. (ppb) = Conc. (µg/m3) x 1/10^6 (g/µg) x 1/1000 (m^3/L) x 24.25 (L/mole) x 1/110.98 (mole/g) x 10^9.

IV. INTERPRETATION OF SIMULATION RESULTS

There are several potential factors contributing to the differences in cancer risk values between simulations with reallocation and without reallocation of December applications. The interaction of these factors is complex. Below are three potential factors:

1) **The actual pounds of 1,3-D applied in a township is higher with reallocation than without reallocation.** The township cap of 1,3-D is an Adjusted Total Pounds (ATP) of 90,250 lbs. The ATP is less than the actual pounds applied due to an Adjustment Factor (AF) that varies by month. The AF is 1.0 for the months of February to November (the actual pounds applied equals the ATP). December and January applications are subjected to a 1.9 AF that allocates 90% more mass from each individual application towards the cap. Therefore, the actual pounds applied in December and January is 44.2% less than the ATP. The ATP is what is totaled to allocate towards the township cap so the township cap is reached with fewer applications (and less actual pounds) when applications occur in December and January. Nineteen percent of the applications occur in December (Table 1). Reallocation of the 263 December SB and TV applications results in the actual pounds of 1,3-D applied during a year more closely approaching the ATP allowance of 90,250 lbs. While this is true for all the 1,3-D use scenarios, the effect of the increased mass on the distribution of air concentrations will likely be larger as the cap increases.

2) **Unlike the Baseline and Max township cap scenarios, the 1.5x Cap township scenario did not include the section weights feature.** The SOFEA model would not run for the 1.5xCap scenario when the section weight model feature was enabled. The section weights feature allocates the 1,3-D use to sections within a township according to historical use patterns. For the Merced SOFEA modeling, when the township cap becomes large, the mass required to be allocated for Township 3 (located in the southeast corner of the Merced 9 township area) was too large for applications to be placed within the available land area. Township 3 only has one section in which 1,3-D use can be allocated under the assigned section weights. As a result, the SOFEA model would not run until the section weights feature was disabled.

3) **There will be an effect on the air concentrations of 1,3-D, and therefore the cancer risk values due to differences in monthly meteorology.** With all other factors held constant, December applications of 1,3-D tend to produce the highest air concentrations, such as those observed in Merced, CA. Months other than December show lower peak air concentrations relative to December. However, the reallocation of the large number of 1,3-D applications from December to other months may cause the annual distribution of 1,3-D air concentrations to shift. One possible cause of the air concentration shift is because more applications are occurring on the same calendar days throughout the year. The total number of applications has not changed but the total number of days in which they can be allocated are reduced. As shown in Table 1, applications are not made evenly throughout the year. Our reallocation method assumes growers will target the same high application frequency months that remain after December is excluded. As a result, the wind direction on those days will affect the overall pattern of air concentrations in a township. There may be lower maximum concentrations, but the overall annual air concentrations will increase (Table 4). This may shift the overall distribution of annual air concentrations to the right and thus increase the cancer risk value, as indicated by the Max and 1.5x Cap scenarios under the simulation with reallocation of December applications.

REFERENCES:

AGRIAN Inc. 2016. AGRIAN, Inc. on-line database. http://www.agrian.com/labelcenter/results.cfm.

Barry, T. 2015. Evaluation of the air dispersion modeling took SOFEA2. Memoradum to David Duncan. Environmental Program Manager II. Environmental Montioring Branch, dated August 12, 2015. In: http://www.cdpr.ca.gov/docs/risk/rcd/dichloro_123115.pdf

ATTACHMENT

SIMULATION OF CANCER RISKS ASSOCIATED WITH DIFFERENT TOWNSHIP CAP SCENARIOS OF MERCED COUNTY FOR 1,3-DICHLOROPROPENE

(DRAFT DOCUMENT FOR INTERNAL DISCUSSION ONLY)

DATE: MAY 12, 2016

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Human Health Assessment Branch

V. METHODOLOGY

For estimating the lifetime exposure of residential bystanders, stimulated annual average air concentrations of 1,3-dichloropropene (1,3-D) coupled with stochastic (i.e., probabilistic) human exposure assessment models were used (Driver *et al.*, 2014; Cryer and Van Wesenbeeck, 2015).

Simulation of 1,3-Dichloropropene Air Concentrations: The simulated air concentrations were generated using SOil Fumigant Exposure Assessment System (SOFEA©), an air dispersion model developed specifically for soil fumigants. SOFEA model runs were based on the current agronomic practices (i.e., field size, application rates and methods, and crop types) and five years of weather data (2005-2009) in Merced, CA. In this exercise, the simulations were conducted with four different township cap scenarios: (1) current 1,3-D use in the 9 townships and in the 16 townships immediately adjacent to the central 9 townships (i.e., baseline), (2) use at the cap of 90,250 lbs (i.e., at max.) in all 9 townships and current use in the 16 townships immediately adjacent to the central 9 townships, (3) use at 1.5 times the cap (i.e., 1.5x) in all 9 townships and in the 16 townships immediately adjacent to the central 9 townships, (4) use at 2.0 times the cap (i.e., 2.0x) in all 9 townships and in the 16 townships immediately adjacent to the central 9 townships (Table 1). Figure 1 shows the 1,3-D allocation as a fraction of the township cap for each of the 4 scenarios. For all SOFEA runs the land use information was used to randomly assign applications. Thus, no applications were assigned to sections designated as Non-Agricultural. For each of the township cap scenarios, the 1,3-D air concentrations were simulated for 100 rounds (i.e., “years”). In each round of simulation, an average concentration of 1,3-D was generated at each of the 11,664 locations or receptors (i.e., 1296 receptors/township x 9 townships = 11,664 receptors over the entire area).

The section probability tool in SOFEA allows the user to allocate the applications to sections according to historical use of 1,3-D. This is a further refinement beyond the land use tool. The combination of the land use and the section probability tools allows the user to develop refined scenarios that reflect the actual practices in the geographic area covered by the simulation. Section probabilities together with the land use information were used for scenarios (1) and (2). For township cap scenarios (3) and (4), it was necessary to deactivate the use of the section probabilities to assign applications within each township. The required 1,3-D use for these 2 scenarios was too high to allow use of the section probabilities. In particular, according to the section probabilities, Township 3 has only 1 section allocated to 1,3-D use. The optimization routine for application assignments would not allow the model to run due to the section probability single section restriction in Township 3.

Simulation of Exposure: The stochastic human exposure assessment models employed is Monte Carlo Annual-Based Lifetime Exposure model (MCABLE) with two mobility assumptions: low and intermediate. These mobility scenarios were selected based on the recommendation by Johnson (2007). For the low mobility assumption, exposures are simulated based solely on the distribution of 1,3-D air concentrations from the highest-exposure township: Township #5. This setting is equivalent to stating that individuals spend their entire lives in Township #5. For the intermediate mobility assumption, the model employs air concentration distributions of 1,3-D from both the highest-exposure township (Township #5) and its surroundings (i.e., Townships #1, 2, 3, 4, 6, 7, 8, and 9). Under this intermediate mobility assumption, individuals are allowed to spend time (i.e., "move around") within five of the nine different townships; however, Township #5 is considered as "home" (i.e., an individual spends most of their time) and the other four are considered as "away from home."

Under each of the mobility settings, the annual average daily dose (ADD) is calculated for every year of a simulated individual's lifetime using the age-and gender-specific breathing rates and body weights together with an annual average of air concentration. The annual average concentration is calculated using the air concentrations selected from township #5 only (i.e., for the low mobility scenario) or 5 of the 9 townships weighted by the proportion of time spent by an individual in each township within the Merced high 1,3-D use area (i.e., for the intermediate mobility scenario). Also, for the intermediate mobility scenario, the selection of a set of 5 air concentrations depends on whether an individual moves into another township (i.e., change in residence) within the same high 1,3-D use area. That is, if an individual moves from one township to another township, the air concentration of "old" township will be replaced by the "new" township for calculating the annual average air concentration.

For calculating the lifetime average daily dose (LADD), the MCABLE considers both the exposures within and outside the Merced high 1,3-D use area. The outside exposures (i.e., background) include those occurring before and after an individual's residence in the high 1,3-D use area. By design, the MCABLE adds ADD values plus background; the sum is then divided by an individual's lifetime. The total number of years when the exposure occurred within the high 1,3-D use area is the difference between the age that an individual moves in (i.e., variable "i") and the age that an individual moves out (variable "n") of the area. For the purpose of this exercise, the MCABLE model was modified such that the total length of time spent in the high 1.3-D use area was restricted to 70 years, and only the "i" was varied stochastically based on specific probability distributions developed by Driver et al. (2015) using a survey conducted in Merced, CA. This is equivalent of assuming that an individual moves into the high use area at any time of their lifetime but stays there for a fixed period of 70 years.

$$\mathrm{ADD}=\left((1\text{-}F_a)\left[\frac{\mathrm{Conc}_i \text{ x } \mathrm{BR}_i}{\mathrm{BW}_i}\right]\right)$$

$$\mathrm{LADD}=\left[\left(\sum_{i}^{n}\mathrm{ADD}_i\right)+\mathrm{Background}\right] \text{ x } \frac{1}{\text{lifetime}}$$

where the summation is over a stochastically determined interval from i to n. For example, $\sum_{10}^{30}$ ADD would be equivalent to the assumption that an individual entered the community at the age of 10 (i.e., i = 10) and left at the age of 30 (i.e., n =30) after staying for 20 years.

F_a = fraction of time spent away from the high 1,3-D use area, (0 for low mobility and 1 for intermediate mobility)
Conc_i = annual average of air concentrations (µg/m^3) in 5 of the 9 townships weighted by the proportion of time spent in each location in interval *i* ,
BR_i = age and gender specific average breathing rate (m^3/day) ,
BW_i = age and gender specific body weight (kg) in interval *i*,
lifetime = 70 years is the assumed lifetime for a male and a female[1],
Background = a value of total ADD due to the background exposure, calculated by adding ADD values from 100 – (n-i) simulation years.

Simulation of 1,3-D Cancer Risk: Distribution of the exposure estimates (i.e., LADD) was generated by Latin hypercube sampling method with 10,000 trials. The individual risk value that constituted the cancer risk distribution was calculated as the LADD (µg/kg/day) times the

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[1] The original lifespan assumption of 75 years for a male and 80 years for a female in the MCABLE are replaced by 70 years (both sexes); 70-year is the typical lifetime exposure duration for use in calculating cancer risk (USEPA, 2002).

estimated 95th percentile upper bound (UL) human cancer potency factor of 0.000014 $[\mu g/kg/day]^{-1}$ for portal-of-entry effect.

VI. SIMULATION RESULTS

Table 1 shows the estimates of cancer risk of individuals living their entire lifetime (i.e., 70 years) in a high 1,3-D use area. As indicated in Table 1, the cancer risk increases with increasing township caps (i.e., from baseline to 2x township cap) and amounts of time-spent (i.e., from intermediate to low mobility) in a high 1,3-D use area. However, because the land use restriction in Township 3 required the section probabilities to be turned off (resulting in the allowance those applications to be placed in any section of all Merced townships), the increase in estimated cancer risks in these 1.5x and 2x scenarios may not be proportional.

For comparison purposes, for each township cap scenario, the cancer risk value was also calculated using a deterministic (i.e., point estimation) approach. Using a list of 100 x 1296 annual average air concentrations of 1,3-D in Township #5, a 95th percentile simulated annual average air concentration was derived for each of the simulation years. This results in a set of 100 values of 95th percentile annual average air concentrations (one 95th percentile annual average from each of the 100 years). Using a normalized breathing rate (nBR) of 0.28 $m^3/kg/day$ for an adult (Andrews and Patterson, 2000), the cancer risk of 1,3-D can be calculated using the following equation:

$$\text{Cancer Risk} = \text{Conc. } (\mu g/m^3) \times \text{nBR } (m^3/kg/day) \times 95^{th} \text{ UL Cancer Potency } [\mu g/kg/day]^{-1}$$

Because the 1,3-D air concentrations were simulated for 100 rounds (i.e., “years”) using SOFEA, for each of the township cap scenarios, 100 values of the 95th percentile air concentrations were generated and therefore, the cancer risk estimates. The minimum and maximum cancer risk values and the corresponding simulated air concentrations of 1,3-D are presented in Table 1 and Table 2, respectively. As expected, because the calculation assumed an individual breathing 95th percentile annual average concentration of 1,3-D throughout a lifetime of 70 years, these point estimates of cancer risk (both minimum and maximum) are higher than the corresponding values based on the more realistic stochastic methodology.

Table 1. 1,3-D Cancer Risks[a] at Different Township Cap Values and Mobility Scenarios

Township Cap	Stochastic (Latin Hypercube)	Mobility	Male	Female
At 2x Cap (All Township)	70-Year Township 5 only	Low	9.16 x 10^{-6}	8.69 x 10^{-6}
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	7.58 x 10^{-6}	7.16 x 10^{-6}
At Max. (All Township)	70-Year Township 5 only	Low	6.41 x 10^{-6}	5.94 x 10^{-6}
At Baseline (Merced)	70-Year Township 5 only	Low	4.99 x 10^{-6}	4.58 x 10^{-6}
At 2x Cap (All Township)	70-Year Township 5 “Home”	Intermediate	8.58 x 10^{-6}	8.05 x 10^{-6}
At 1.5x Cap (All Township)	70-Year Township 5 “Home”	Intermediate	7.01 x 10^{-6}	6.54 x 10^{-6}
At Max. (All Township)	70-Year Township 5 “Home”	Intermediate	6.05 x 10^{-6}	5.52 x 10^{-6}
At Baseline (Merced)	70-Year Township 5 “Home”	Intermediate	4.62 x 10^{-6}	4.23 x 10^{-6}
Township Cap	**Point (95th %tile Mean Values)**	**Mobility**	**Min[b]**	**Max[b]**
At 2x Cap (All Township)	70-Year Township 5 only	Low	1.65 x 10^{-5}	2.30 x 10^{-5}
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	1.30 x 10^{-5}	1.77 x 10^{-5}
At Max. (All Township)	70-Year Township 5 only	Low	7.11 x 10^{-6}	1.14 x 10^{-5}
At Baseline (Merced)	70-Year Township 5 only	Low	6.62 x 10^{-6}	9.84 x 10^{-6}

[a] The individual risk value that constituted the cancer risk distribution was calculated as the LADD (μg/kg/day) times the human cancer potency factors of 0.000014 [μg/kg/day]$^{-1}$ for portal-of-entry effect. For cancer risk associated with the systemic mode-of-action (MOA), all the risk values will be increased by ~3.4 times (i.e., 0.000048 [μg/kg/day]$^{-1}$/0.000014 [μg/kg/day]$^{-1}$ ≈ 3.4).

[b] Corresponding simulated air concentrations of 1,3-D are provided in Table 2.

Table 2. Simulated 1,3-D Concentrations at Different Township Cap Values and Mobility Scenarios

Township Cap	Point (95th %tile Mean Values)	Mobility	Min	Max
			(μg/m^3)	
At 2x Cap (All Township)	70-Year Township 5 only	Low	4.21	5.87
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	3.33	4.52
At Max. (All Township)	70-Year Township 5 only	Low	1.81	2.91
At Baseline (Merced)	70-Year Township 5 only	Low	1.69	2.51
			(ppb)[a]	
At 2x Cap (All Township)	70-Year Township 5 only	Low	0.93	1.29
At 1.5x Cap (All Township)	70-Year Township 5 only	Low	0.73	1.00
At Max. (All Township)	70-Year Township 5 only	Low	0.40	0.64
At Baseline (Merced)	70-Year Township 5 only	Low	0.37	0.55

[a] Conc. (ppb) = Conc. (μg/m3) x 1/10^6 (g/μg) x 1/1000 (m^3/L) x 24.25 (L/mole) x 1/110.98 (mole/g) x 10^9

Figure 1. Illustration of the township cap scenarios 1 through 4. The cap multiplier is shown for each township included in the simulation. Use of section weights randomly assigns applications according to historical use.

Township Ordering (townships outside the central 9 townships are not numbered)

	Twn7	Twn8	Twn9	
	Twn4	Twn5	Twn6	
	Twn1	Twn2	Twn3	

Scenario 1 – with section weights

0.00	0.69	0.55	0.06	0.37
0.00	1.00	1.00	1.00	0.60
0.00	0.61	1.00	1.00	0.00
0.16	0.00	0.32	0.16	0.00
0.00	0.00	1.31	0.51	0.00

Scenario 2 – with section weights

0.00	0.69	0.55	0.06	0.37
0.00	1.00	1.00	1.00	0.60
0.00	1.00	1.00	1.00	0.00
0.16	1.00	1.00	1.00	0.00
0.00	0.00	1.31	0.51	0.00

Scenario 3 – without section weights

1.5	1.5	1.5	1.5	1.5
1.5	1.5	1.5	1.5	1.5
1.5	1.5	1.5	1.5	1.5
1.5	1.5	1.5	1.5	1.5
1.5	1.5	1.5	1.5	1.5

Scenario 4 – without section weights

2.0	2.0	2.0	2.0	2.0
2.0	2.0	2.0	2.0	2.0
2.0	2.0	2.0	2.0	2.0
2.0	2.0	2.0	2.0	2.0
2.0	2.0	2.0	2.0	2.0

REFERENCES:

Andrews, C., and Patterson, G. 2000. Interim Guidance for Selecting Default Inhalation Rates for Children and Adults. Memorandum to Worker Health and Safety Branch Staff and Medical Toxicology Branch Staff, from Andrews, Chuck Chief, Worker Health and Safety Branch and Patterson, Gary, Chief, Medical Toxicology Branch, dated December 1. http://www.cdpr.ca.gov/docs/whs/memo/hsm00010.pdf.

Cryer, S. A., and Van Wesenbeeck, I. J. 2015. SOil Fumigant Exposure Assessment System (SOFEA©) User's Guide. Version 2.

Driver, J. H., Ross, J. H., Cochran, R. C., Holden, L., VanWesenbeeck, I., and Price, P. S. 2014. Evaluation Of Potential Human Health Effects Associated With The Agricultural Uses Of 1,3-D: Refined Stochastic Risk Analysis. Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, Indiana 46268, USA. (DPR Vol. No. 50046-0220, Record No. 282371) 120.

Johnson, B. 2007. Simulation of Concentrations and Exposure Associated with Dow Agrosciences-Proposed Township Caps for Merced County for 1,3-Dichloropropene. Memorandum to, dated March 29. http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/mercd_telone.pdf.