Appendix F –CALDPR Cited Methyl Bromide Field Volatility Studies and Composite Temporal Flux Profiles

In January 2000, CDPR generated a memorandum outlining their recommendations for methyl bromide buffer zones for field fumigations. The recommendations were based on roughly 47 air monitoring studies dating from 1992 through 1999. The studies were grouped by application method and tarping techniques and an emission ratio, or the proportion of applied methyl bromide that volatilized, was derived for each grouping. This would then allow CDPR to derive buffer zone estimates for workers and bystanders for any field size and application rate, as it was assumed that a linear relationship between the amount applied (e.g., application rate) and the amount released (e.g., flux rate) existed.

CDPR used the data from these studies to derive an equation that would estimate flux rate as a function of time (Johnson, 1999; Johnson and Segawa, 2000; Johnson, 2004). The final equation was:

$$y = Ae^{-0.5\left[\frac{\ln\left(\frac{x}{B}\right)}{C}\right]^2}$$

where y is the fraction of applied mass emitted per hour, x is the time in hours after the start of application, A is a constant that scales the overall function height and area, B is a constant that determines where the peak is, and C is a constant that determines the width of the function.

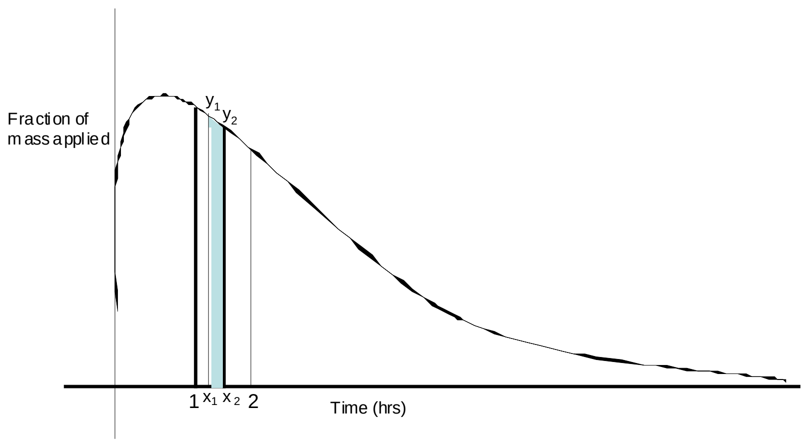
The specific data used for the basis of the above equation is shown in Table F-1 below.

Table F-1. Summary of field study parameters used to develop methyl bromide flux profiles.

Application Method	Study Conductors	Study Date	County	Application Rate	24-hour Volatile Fraction
Broadcast Tarped Shank Injection	Trical, Inc.	8/19/92	Monterrey	186	0.26
	Environmental Hazards	9/24/92	Monterrey	196	0.16
Bedded Tarped Shank Injection	Bolsa Research	6/24/99	Orange	176	1.0
	Bolsa Research	6/30/99	San Luis Obispo	245	0.76
	Bolsa Research	6/24/99	Orange	177	1.0
	Bolsa Research	6/30/99	San Luis Obispo	174	0.76
	CALDPR (1998)	10/6/98	San Luis Obispo	206	1.00
Deep Shank Injection Untarped	Siemer and Associates	10/21/92	Kern	396	0.62
	Siemer and Associates	3/8/93	Fresno	396	0.44

Application Method	Study Conductors	Study Date	County	Application Rate	24-hour Volatile Fraction
Deep Shank Injection Untarped	Siemer and Associates	3/13/93	Madera	400	0.22
	Siemer and Associates	10/31/95	San Joaquin	450	0.08
Hot Gas Chemigation	CALDPR, 1996	12/11/96	Riverside	200	1.00
	CALDPR, 1997	1/20/97	Kern	200	0.64
	CALDPR, 1997	1/27/97	Imperial	200	1.00

Figure F-1. Flux rate estimation, area under the curve.



To estimate flux rate for an hour, the area underneath the curve generated by this equation was used. For each hour, values of y were calculated for each minute. These values are multiplied by the effective broadcast application rate (i.e., the amount of fumigant applied to the entire area of the field, not just the treated area of the field) to estimate an instantaneous flux rate for distinct minutes. The area underneath the curve for a one minute time step was estimated using the area of a trapezoid, A=1/2h(a+b), where h=x2-x1, and a and b are the incremental values of the instantaneous flux rate (see Figure 1). The areas for an hour were summed to provide an estimate of the flux rate over that hour.

Table 9 depicts the values for the various parameters used to estimate flux rates for methyl bromide applications. Table 10 depicts the flux rates for the first 48 hours for the various application methods used for methyl bromide, corrected to a maximum effective broadcast application rate of 430 lbs ai/acre. It should be noted that, subsequent to the publication of the draft risk assessment, conversations with CDPR indicated that the application rate used in the flux rate equation for the bedded tarped application was lbs ai per total acreage, corresponding to an equivalent application rate of 430 lbs ai/treated acre. Consequently, the flux rates did not need to be adjusted for this type of application. Subsequent model runs for bedded tarped applications used the flux rates depicted in Table 11.

Table F-2. Coefficients used for flux rate estimation, field use.

Application Method	Effective Broadcast Application Rate (lbs ai/acre)	A	B	C
Tarped	400	0.013723	15.5127	0.84929
Bedded, tarped	250	0.132867	0.602401	1.53484
Deep, untarped	400	0.016618	12.36407	1.081679
Drip, hot gas	225	1.11E-01	6.414006	0.495166

Table F-3. Flux rates (μg/m²s), by application method, for methyl bromide field use normalized to 430 lbs. a.i./A.

Hour	Tarped [1]	Bedded, Tarped [1]	Deep, untarped [2]	Drip, hot gas [3]
1	0.2	1530.18	4.42	0.15
2	4.63	1493.36	33.61	29.26
3	18.54	1161.48	74.48	254.32
4	39.63	924.76	112.35	703.00
5	63.52	755.82	143.49	1143.44
6	87.1	631.12	167.83	1409.25
7	108.61	536.14	186.25	1481.21
8	127.26	461.88	199.78	1412.05
9	142.83	402.54	209.39	1264.36
10	155.4	354.27	215.87	1086.08
11	165.21	314.39	219.87	907.12
12	172.57	281.01	221.92	743.25
13	177.8	252.76	222.42	601.04
14	181.21	228.62	221.71	481.74
15	183.09	207.8	220.05	383.86
16	183.68	189.72	217.65	304.74
17	183.2	173.9	214.68	241.43
18	181.85	159.97	211.28	191.10
19	179.79	147.65	207.55	151.27
20	177.16	136.69	203.59	119.82
21	174.07	126.89	199.45	95.02
22	170.63	118.1	195.2	75.47
23	166.92	110.17	190.88	60.05
24	163.01	103.01	186.53	47.88
25	158.95	96.51	182.18	38.26
26	154.81	90.59	177.85	30.64
27	150.6	85.19	173.55	24.60

Hour	Tarped [1]	Bedded, Tarped [1]	Deep, untarped [2]	Drip, hot gas [3]
28	146.38	80.24	169.32	19.80
29	142.16	75.7	165.14	15.97
30	137.98	71.53	161.05	12.92
31	133.83	67.68	157.03	10.47
32	129.75	64.12	153.1	8.51
33	125.75	60.83	149.26	6.94
34	121.82	57.78	145.52	5.66
35	117.99	54.94	141.86	4.64
36	114.25	52.3	138.3	3.81
37	110.6	49.84	134.84	3.13
38	107.06	47.54	131.47	2.58
39	103.62	45.38	128.19	2.13
40	100.28	43.37	125	1.76
41	97.04	41.48	121.91	1.46
42	93.9	39.71	118.9	1.22
43	90.86	38.04	115.98	1.01
44	87.92	36.47	113.14	0.85
45	85.08	34.99	110.38	0.71
46	82.34	33.6	107.71	0.59
47	79.68	32.28	105.11	0.50
48	77.12	31.03	102.59	0.42

[1] From Johnson, 1999.
[2] From Johnson and Segawa, 2000
[3] From Johnson, 2004