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MEMORANDUM

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SUBJECT: DESCRIPTION OF THE METHOD USED TO EXPAND THE CHLOROPICRIN
BUFFER ZONE TABLES

Background

The Department of Pesticide Regulation (DPR) has developed a mitigation plan for the use of the soil fumigant chloropicrin (DPR, 2015). Part of the mitigation plan includes required buffer zones that were developed as described in Barry (2014). The buffer zone development included combinations of 6 field sizes from 1 to 40 acres and 8 application rates from 10 lb/ac to 350 lb/ac. The suggested permit conditions implementing the mitigation plan will include much finer divisions of application sizes and rates than were used to develop the buffer zones. This memorandum describes the method used to expand the Barry (2014) buffer zone tables to include combinations of acreage and application rates that fill the gaps between the combinations used to develop the buffer zones.

Label vs. DPR buffer zones

The DPR mitigation plan (DPR, 2015) included buffer zones for 12 tarp type/application method combinations. The DPR *calculated* buffer zones for six of the methods are smaller than those currently required by labels. Since DPR cannot implement less stringent requirements than labels, the DPR *required* buffer zones for the following six methods will be the same as those specified by labels, except when the DPR minimum buffer zone distance is required.

- TIF¹ tarp broadcast shank
- TIF tarp bed shank
- TIF tarp strip deep shank
- TIF tarp drip

¹ Totally Impermeable Film, assigned a buffer zone reduction credit of 60% by labels.



- Non-TIF tarp broadcast shank
- Untarped drip

All of the DPR calculated buffer zones are smaller than the label buffer zones for the methods listed above. However, some of the DPR minimum buffer zones are larger than the 25-foot minimum buffer specified by labels. The DPR mitigation plan (DPR, 2015) specifies the following minimum buffer zone distances.

- TIF: 25 feet
- Non-TIF for ≤ 6 acres: 60 feet
- Non-TIF > 6 acres: 100 feet
- Untarped: 100 feet

Methods

The DPR buffer zone tables developed as described in Barry (2014) are used as the basis for the expanded buffer zone tables for the six tarp type/application method combinations listed below.

- Non-TIF bed shank
- Non-TIF strip shank
- Non-TIF drip
- Untarped shallow broadcast shank
- Untarped deep broadcast shank
- Untarped bed shank

The 6 combinations of tarp type/application method listed above were expanded into finer divisions. The expanded tables were produced using the Ventura County and San Joaquin County weather for each of the 6 combinations of tarp type and application method. Thus, the final 12 expanded tables were produced.

Table 1 shows the buffer zone table developed in Barry (2014) for the Poly/Bed (Non-TIF bed shank) application method under Ventura County weather conditions. This buffer zone table will be used to illustrate the expansion process. All 12 expanded tables followed the same procedures.

Table 1. Poly/Bed (Non-TIF bed shank) application method buffer zones (ft) for Ventura County weather conditions developed as described in Barry (2014).

Application Rate (lb/ac)	Application Size (ac)					
	1	5	10	20	30	40
10	0	0	0	0	0	0
50	0	0	0	16	16	16
100	0	16	16	218	322	417
150	0	159	332	571	774	951
200	16	337	573	916	1197	1464
250	16	479	777	1237	1616	1956
300	119	622	981	1540	2014	2464
350	220	746	1179	1840	2413	2958

Table 1 is comprised of 48 cells that contain the combinations of 8 application rates and 6 application sizes. The expanded buffer zone table generated using Table 1 is comprised of 512 cells containing combinations spanning 32 application rates and 16 application sizes. The largest and smallest application rates and sizes in the expanded buffer zone table are the same as shown in Table 1. The table expansion occurs in between the application rate and field size values shown in Table 1. The buffer zones shown in Table 1 were developed using computer intensive air dispersion modeling and post processing. Thus, it is not possible to develop the desired 512 cell expanded table using the method presented in Barry (2014).

TableCurve 2D V5.0 (AISN, 2000) was used to accomplish the buffer zone table expansion. TableCurve 2D is an automated curve fitting program that has more than 3,600 equations in the curve fitting library. TableCurve 2D fits sets of equations quickly and easily. The “Curve-Fit Simple Equations” set was chosen for this analysis. The “Curve-Fit Simple Equations” set of equations is comprised of the TableCurve 2-D 2-parameter equations in addition to non-linear power and exponential functions. The curve fitting for the buffer zone table expansion is done with the aim being to select an interpolation tool to simply and accurately fill in the buffer zone values in between the application rate and size combinations used in the initial development of Table 1. Thus, the closeness of the equation fit is most important. Linear or non-linear functions can be chosen, depending upon the best fit.

The expansion of Table 1 was accomplished in two steps. Step 1: The application rates in the table are expanded to the desired set. For each of the 6 application sizes shown in Table 1, equations were fit that express the buffer zone length as a function of application rate. Among all the fit equations, an equation that had an $R^2 > 99\%$ was selected as the best fitting function. That function was then evaluated for the 32 application rates desired in the expanded table. For this phase, shown in Table 2, there are no application rates less than 50 lb/ac because all application rates less than 50 lb/ac returned the minimum buffer distance or less. Thus, for the Poly/Bed (Non-TIF bed shank) case, this process produced an intermediate buffer zone table with 186 cells comprised of 6 application sizes and 31 application rates (Table 2).

Table 2. Poly/Bed (Non-TIF bed shank) application method and Ventura County weather. Step 1: Intermediate buffer zone table generated for each application size (ac) over 31 application rates (application rates below 50 lb/ac all had the minimum buffer).

Application Rate (lb/ac)	Application Size (ac)					
	1	5	10	20	30	40
50	0	0	0	16	16	16
60	0	16	16	41	65	83
70	0	16	16	83	122	154
80	0	16	16	133	189	236
90	0	16	16	188	262	326
100	0	16	16	246	340	422
110	0	37	87	308	421	521
120	0	64	149	371	504	622
130	0	95	208	436	589	725
140	0	128	264	501	674	830
150	0	162	319	567	760	935
160	16	196	372	634	847	1040
170	16	230	423	700	933	1145
180	16	264	473	767	1019	1251
190	16	297	522	834	1105	1356
200	16	330	569	900	1191	1460
210	16	363	615	966	1277	1564
220	16	394	660	1032	1362	1668

230	16	425	704	1097	1446	1770
240	16	456	747	1162	1530	1873
250	16	485	789	1227	1613	1974
260	37	514	830	1291	1696	2075
270	58	542	871	1355	1778	2175
280	78	570	910	1418	1860	2274
290	99	596	949	1481	1941	2372
300	119	622	988	1544	2021	2470
310	139	648	1026	1606	2101	2567
320	160	673	1063	1667	2180	2663
330	180	697	1099	1728	2258	2759
340	200	721	1135	1789	2336	2853
350	220	744	1171	1849	2414	2947

Step 2: The 186 cell intermediate table from Step 1 (Table 2) is used to expand the set of application sizes for each of the 32 application rates to the 16 application sizes desired in the final buffer zone table. The same curve fitting, selection, and evaluation of the selected fit equation described in the first step was followed for Step 2. Table 3 shows the fully expanded buffer zone table generated in Step 2.

The table generated in Step 2 (Table 3) is not the final table, however. The lowest application rates and smallest application sizes tend to require either the PERFUM minimum buffer zone of 16 feet or no buffer zone at all (0 feet). Depending upon the pattern of buffer zone distances in the original buffer zone tables from Barry (2014), the buffer zone sizes in the expanded buffer zone tables at the lower application rates and application sizes are manually filled in with the default values of 0 feet or 16 feet. Thus, the final expanded table for each tarp type/application method and weather data location will be a combination of 1) the TableCurve 2D curve fitting and evaluation results, and 2) manual filling with the default buffer zone values of 0 feet and 16 feet. The expanded tables used in the permit conditions will be further modified to reflect DPR's minimum buffer zones described above, and rounding to the nearest multiple of five feet.

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References

AISN. 2000. TableCurve 2D automated curve fitting software. User's manual. AISN Software.

Barry, T. 2014. Development of chloropicrin buffer zones – revised. Memorandum to David Duncan. Environmental Program Manager II. Dated October 31, 2014. Environmental Monitoring Branch. Department of Pesticide Regulation. California Environmental Protection Agency. Sacramento, CA 95812-4015.<
http://www.cdpr.ca.gov/docs/whs/pdf/appendix_4_buffer_zones_memo.pdf>

DPR. 2015. Chloropicrin mitigation measures. Control of resident and bystander acute exposure from soil fumigation applications. Dated 1/6/2015. Department of Pesticide Regulation. California Environmental Protection Agency. 1001 I Street, Sacramento, CA 95812.
<http://www.cdpr.ca.gov/docs/whs/pdf/chloropicrin_mitigation_app_1-3.pdf>

Table 3. Poly/Bed (Non-TIF bed shank) application method and Ventura County weather. Buffer zone table generated in Step2 for each application rate (lb/ac) over 16 application sizes (ac).

App Size (ac)	Application Rate (lb/ac)																														
	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
1	0	0	0	0	0	0	0	0	0	0	0	16	16	16	16	16	16	16	17	17	17	39	169	180	190	200	210	220	230	239	248
2	0	16	16	16	16	16	16	17	22	37	49	72	84	96	107	118	129	161	171	181	191	203	274	290	306	321	336	352	366	381	395
3	0	16	16	16	16	16	16	31	40	74	93	120	139	158	176	194	212	247	263	278	293	310	362	383	403	423	443	462	481	500	519
4	0	16	16	16	16	16	20	47	61	107	133	163	188	213	237	260	283	320	340	360	380	401	442	467	491	515	538	562	584	607	629
5	0	16	16	16	16	16	31	65	83	138	169	203	233	262	291	319	347	386	410	434	458	482	516	544	572	599	626	653	679	705	730
6	0	16	16	16	16	16	44	83	107	167	202	239	274	307	341	373	405	446	474	501	529	557	586	617	648	679	709	739	768	797	825
7	0	16	16	16	16	16	59	103	132	195	234	274	312	350	387	424	460	502	533	564	595	627	652	686	720	754	787	820	852	884	915
8	0	16	16	16	16	16	75	123	157	221	264	307	349	390	431	471	511	554	589	624	658	692	715	752	789	826	862	897	932	967	1001
9	0	16	16	16	16	16	92	143	182	247	293	339	384	429	473	516	559	604	642	680	717	755	776	816	856	895	933	971	1009	1046	1083
10	0	16	16	16	16	16	110	164	207	271	320	369	417	465	513	559	605	652	693	734	774	814	835	877	920	961	1002	1043	1083	1123	1162
15	16	29	59	90	133	172	206	266	329	385	447	508	569	630	691	751	810	866	920	974	1028	1081	1106	1160	1214	1267	1320	1372	1423	1474	1525
20	16	42	84	130	188	243	297	359	436	487	560	630	703	774	846	916	986	1052	1118	1183	1248	1313	1349	1414	1478	1542	1604	1666	1728	1789	1849
25	16	54	105	162	230	298	373	441	527	582	663	743	824	905	985	1065	1144	1219	1295	1371	1446	1521	1575	1649	1722	1795	1866	1938	2008	2078	2147
30	16	64	122	189	265	344	433	511	602	671	760	848	937	1025	1113	1201	1288	1372	1458	1544	1629	1713	1787	1870	1951	2032	2112	2192	2270	2349	2426
35	16	74	138	214	296	384	480	571	665	756	851	947	1042	1138	1233	1328	1423	1515	1611	1705	1799	1891	1989	2079	2168	2257	2345	2432	2519	2605	2690
40	16	83	153	237	324	421	516	621	717	837	938	1041	1143	1244	1346	1448	1549	1650	1754	1857	1959	2059	2182	2279	2376	2472	2567	2662	2756	2849	2942